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**The New York Fire Alarm System.** ELSEWHERE in our columns this week will be found an account of the beautiful and elaborate system of signaling that has gone so far toward making the New York fire department peerless in point of efficiency. It is the growth, for the most part, of recent years, for many old New Yorkers remember the period, not so very long ago, that fires were reported to stations by messenger, or else announced on the fire bells from observation towers scattered about the city. Now all is changed, and whenever a fire is discovered within a few seconds its location can be signaled to the central station and back again to the proper engine house, calling the fire apparatus at once into play. The electrical system is of the most complicated character, including as it does a complete set of signaling apparatus from all the fire boxes, wires to every engine, and the most elaborate arrangement of automatic devices for insuring the proper operation of the signals. Its present perfection has been the development of years.

**Electricity in Mining.** ON another page we publish the first of a series of articles on the application of electricity to mining, a subject concerning which much has been written in a somewhat desultory fashion, but which needs assuredly a complete and continuous treatment. Few mine managers even now have an adequate idea of the convenience and cheapness of electric service in improving the conditions of mine operation. We may look at the subject from two standpoints: First, as a matter of convenience and efficiency, the distribution of power by electricity over the distances actually necessary in working mines is far ahead of anything that has ever been attempted by other means. Even supposing cheap fuel were readily obtainable, the electric pump and drill and hoist and coal cutter can be operated at considerably less expense than by compressed air or any other known means. Second, electricity has an additional and very great advantage in the ability it gives the engineer to obtain his power at a point where fuel is very cheap or water power can be easily obtained, and transmit it with very slight loss to a distant mine which otherwise would be either compelled to suspend operations entirely or put in engines or compressed air apparatus under circumstances where the price of fuel would be almost prohibitive. These latter conditions exist at very many points throughout the Western mining districts, where veins of the richest ore are sometimes found high among the mountains, where coal cannot be had unless carted for miles, no wood is within convenient reach, and even water powers are distant. The very successful use of electricity in coal mines where fuel costs almost nothing is a sufficient example of its peculiar advantages as regards small cost of distribution and vast convenience of application. A portion of the present account is from the pen of Hon. R. M. Haseltine, State Inspector of Mines for Ohio, who has made an elaborate study of coal cutters. In the succeeding papers the various practical details of mining installations will be taken up and a complete account of this branch of electrical engineering will be placed before our readers.

**Static and Dynamic Electricity.** THE text books even up to the present time are replete with separate treatments of these two closely allied branches of electrical phenomena. The time was, in the days when the battery was the principal source of electrical current and the frictional machine of high electromotive forces, when the two-phase of the subject appeared as widely distinct as possible. It is curious to note to-day how all this is changed. At present, even in commercial work, effects that used to be considered purely static turn up to influence in a very striking fashion the solution of certain electrical problems; for example, when the Lauffen-Frankfort plant was only projected prophecies were openly made that it could never prove successful on account of the enormous static capacity of the insulators. Although this fear proved to be entirely groundless it is interesting to know that the enormous tension frequently punctured the insulators, making a minute hole through the porcelain as sharply cut as that which would be produced by the discharge of an enormously powerful influence machine or induction coil. We have recently described experiments in the commercial transmission of current at an electromotive force of over 40,000 volts, which is quite comparable with that given by large Ruhmkorff coils and static machines. Then comes the Ferranti effect to disturb the equilibrium of potential in underground mains, and then the condenser, sacred in the text-books to the memory of static charge, appears as in the Stanley motor described sometime since in our columns, to aid in the solution of the alternating current motor problem that has puzzled the brains of inventors. It is about time to drop the old treatment of matters electrical and discuss not current and charge but electrical energy alone, as influenced by the various conditions of capacity, resistance and self-induction, introduced by its employment under various circumstances.

**Motor Regulation.** IN another column we give the long expected account of Mr. H. Ward Leonard's innovation in motor regulation which made something of a sensation at the Montreal Convention of the National Electric Light Association, and has been the subject of considerable comment ever since. The invention consists merely of an arrangement for regulating the applied electromotive force to control the speed of the driven motor and, quite independently, regulating the applied current in accordance with the demands for work. The former end is reached by separately exciting the fields of both generator and motor from a source of constant potential and then modifying the resistance of the generator field to control the electromotive force. The armature circuits of the two machines are directly in series, so that the supply of current is regulated automatically. It is almost unnecessary to state that the range of variation in speed and power is enormous, while the efficiency of the combination remains tolerably high at all speeds. The most serious objection is the necessary complication, which probably has deterred inventors from following out a similar line in the past. To install, for example, this regulating motor in a building supplied from the street mains only, it is necessary to put in a motor and generator as well as a motor intended for the regular work. The first motor operates the dynamo supplying current for the working motor, while the street mains excite the fields of all three machines. Mr. Leonard has gone further and proposes to use a similar arrangement on street cars. In this case the combination of motor and generator is of a capacity considerably less than the ultimate output of the motors and serves to start them and run them efficiently at moderate speeds, while later for heavy service or a much enhanced speed the motors would be employed quite as usual except that all the machines would be shunt wound. This is not really a serious objection, as it is altogether probable that the shunt motor has been rather needlessly abandoned by electric railway engineers. Still other arrangements proposed by the same ingenious inventor contemplate a four-wire power service, which would enable six different speeds to be reached while the motor would be perfectly self regulating at any one of them. Of the efficiency and convenience of so complete a method of regulation there can be little doubt. The questions involved are really commercial and must be answered either for or against the device by commercial tests.

**The Berliner Microphone Patent.** RARELY has a patent on any subject whatever caused so profound a sensation as the granting to Emile Berliner on Nov. 17 of what on its face appeared to be a broad claim on the microphone transmitter now used well nigh universally wherever the telephone exists. Electrical circles were less surprised than the general public, but a feeling akin to consternation has pervaded the atmosphere during the past week. It is indeed an extraordinary patent, no less on account of the sweeping character of some of its claims than by reason of its remarkable history in the Patent Office. For an application to remain for one cause or another locked up in the Patent Office for 14¼ years before its issue is almost unique, but additional interest is lent to this unusual procedure by the fact that this patent belongs to the great monopoly whose fundamental claims have been held successfully against all comers for 15 years, that has almost ended its term of life and needs—though less than most have supposed—such a patent as that issued to Berliner to insure its continued existence. Elsewhere in our columns may be found an account by Berliner himself of the steps that led him in the year following the announcement of Bell's great invention to devise a method, nominally, at least, secured to him by the present legal action. It is an interesting story, telling as it does of his struggles to improve the telephone in the face both of inherent difficulties and sad lack of apparatus. We have in addition given a somewhat elaborate discussion of the character of the Berliner patent and its bearing on the future of the telephone business. It will undoubtedly stir up litigation, but will suffer under the disadvantage of adverse public sentiment and conditions widely different from those that enabled Alexander Graham Bell to hold his fundamental claims. There are various lines of attack on the transmitter patent that will doubtless be assiduously followed so soon as the subject comes before the courts. The state of the art at the time of the invention, the singular history of the claims in the Patent Office, and the inventor's important disclaimer in the patent at issue, all will have a profound bearing on the final result. With respect to the long delay in granting this patent it seems likely that the anathemas launched by the daily press against the Bell Telephone Company are not altogether deserved; for although the Berliner-Edison inteference was not settled until 1886, about eight years after it was declared, the patent has been delayed since that time by the existence of an application on the part of the notorious Drawbaugh, which never came in direct conflict with either of the claims mentioned but was after long delays rejected on the ground that the carbon transmitter had been in use for two years before the application was entered in 1880. It was quite as much in the interest of the Drawbaugh adherents as the American Bell Telephone Company to delay a final settlement of the rights in the case, for the more nearly the fundamental patent was to expiration the more valuable would any broad claim on the transmitter become. Some months since, Feb. 7, 1891, we reviewed the state of the telephone patents, and called attention to the existence of the Drawbaugh claim. Finally thrown out of the Patent Office, it allowed the Bell Telephone Company to obtain the patent whose advent has been hailed with almost hysterical objurgations. The fact is that albeit the Berliner microphone patent is broad and of unquestionable importance, it has by no means so great a value to the telephone monopoly as would make it vitally necessary that it should be sustained. A large number of subsidiary and accessory patents on telephonic apparatus of an infinite variety, as well as the commercial security assured by immense plants and important franchises, are likely to give the present telephone organization a lease of life extending considerably beyond the expiration of the famous 1876 patent, quite independent of the transmitter now in question. Alexander Graham Bell's patent of Jan. 30, 1877, which covers in a very effective way the electromagnetic telephone receiver, will enable practical apparatus to be held from public use until Jan. 30, 1894. After that date the receiver is free, but the microphone transmitter, covered—quite aside from the present issue—by patents both to Edison and Berliner, will not become public property before the middle of 1895. After that the general use of the telephone can only be held as a monopoly in virtue of claims on subsidiary apparatus. That, however, may still be of considerable importance.

## Latest Foreign Electrical News.

*(By Cable from Our Own Correspondent.)*

London, Nov. 23, 1891.—The success of the City & South London Railway continues to stimulate similar enterprises, and there have recently been projected several new tubular lines across London, some of them in directions where additional facilities are very much needed.

The electric lighting of the streets in the city is not going on with anything like the rapidity that could be desired. The contracting company has already applied for an extension of one year from the time originally allowed for the completion of the street lighting. The contracts were signed nearly two years ago and the slow progress of the work has caused much dissatisfaction. It is now only a few months since the lights were turned on, and the result is such as to stimulate public interest in accelerating the work.

## Moonlight Tables for December, 1891.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of December, under his modified form of moon schedule:

TABLE NO. 1.
Standard Moonlight, Philadelphia System.

| Date. | Light. | Date. | Exting. |
|---|---|---|---|
| 1 | 5:05 P. M. | 2 | 6:05 A. M. |
| 2 | 5:05 | 3 | 6:05 |
| 3 | 5:05 | 4 | 6:05 |
| 4 | 5:05 | 5 | 6:05 |
| 5 | 5:05 | 6 | 6:10 |
| 6 | 8:45 | 7 | 6:10 |
| 7 | 9:55 | 8 | 6:10 |
| 8 | 11:10 | 9 | 6:10 |
| 9 | | 9 | |
| 10 | 12:20 A. M. | 10 | 6:10 |
| 11 | 1:35 | 11 | 6:10 |
| 12 | 2:45 | 12 | 6:10 |
| 13 | 4:00 | 13 | 6:10 |
| 14 | No light. | 14 | No light. |
| 15 | No light. | 15 | No light. |
| 16 | No light. | 16 | No light. |
| 17 | 5:05 P. M. | 17 | 7:40 P. M. |
| 18 | 5:05 | 18 | 8:45 |
| 19 | 5:05 | 19 | 9:45 |
| 20 | 5:05 | 20 | 10:50 |
| 21 | 5:05 | 21 | 11:55 |
| 22 | 5:10 | 23 | 12:50 A. M. |
| 23 | 5:10 | 24 | 1:50 |
| 24 | 5:10 | 25 | 2:50 |
| 25 | 5:10 | 26 | 3:50 |
| 26 | 5:10 | 27 | 4:55 |
| 27 | 5:10 | 28 | 6:20 |
| 28 | 5:10 | 29 | 6:20 |
| 29 | 5:10 | 30 | 6:20 |
| 30 | 5:15 | 31 | 6:20 |
| 31 | 5:15 | 1 | 6:20 |

Total hours lighting, 243.20.

TABLE NO. 2.
Frund's New Moonlight System.

| Date. | Light. | Date. | Exting. |
|---|---|---|---|
| 1 | 5:05 P. M. | 2 | 6:05 A. M |
| 2 | 5:05 | 3 | 6:05 |
| 3 | 5:05 | 4 | 6:05 |
| 4 | 5:05 | 5 | 6:05 |
| 5 | 5:05 | 6 | 6:00 |
| 6 | 5:05 | 7 | 6:00 |
| 7 | 5:05 | 8 | 6:00 |
| 8 | 5:05 | 9 | 6:00 |
| 9 | 5:05 | 9 | 12:00 M. |
| 10 | 12:20 A. M. | 10 | 6:10 A. M. |
| 10 | 5:05 P. M. | 10 | 12:00 M. |
| 11 | 1:35 A. M. | 11 | 6:10 A. M. |
| 11 | 5:05 P. M. | 11 | 12:00 M. |
| 12 | 5:05 | 12 | 12:00 |
| 13 | 5:05 | 13 | 12:00 |
| 14 | 5:05 | 14 | 12:00 |
| 15 | 5:05 | 15 | 12:00 |
| 16 | 5:05 | 16 | 12:00 |
| 17 | 5:05 | 17 | 12:00 |
| 18 | 5:05 | 18 | 12:00 |
| 19 | 5:05 | 19 | 12:00 |
| 20 | 5:05 | 20 | 12:00 |
| 21 | 5:05 | 21 | 12:00 |
| 22 | 5:10 | 23 | 12:50 A. M. |
| 23 | 5:10 | 24 | 1:50 |
| 24 | 5:10 | 25 | 2:50 |
| 25 | 5:10 | 26 | 3:50 |
| 26 | 5:10 | 27 | 4:55 |
| 27 | 5:10 | 28 | 6:20 |
| 28 | 5:10 | 29 | 6:20 |
| 29 | 5:10 | 30 | 6:20 |
| 30 | 5:15 | 31 | 6:20 |
| 31 | 5:15 | 1 | 6:20 |

Total hours lighting, 319.15.

## The Berliner Patent.

Seldom has the issue of a United States patent to an inventor in any field of activity raised such widespread public interest or called forth so many expressions of indignation as the granting, on Nov. 17, of the basic patent on the microphonic telephone transmitter to Emile Berliner. For many months it had been rumored that the American Bell Telephone Company, whose natural term of monopolistic life was supposed to end in 1893, was about to secure the issuance from the Patent Office of an important patent long hidden in the archives at Washington, and destined to be the instrument of prolonging one of the greatest monopolies of modern times for 17 years from the date of issue.

It had been known, too, that the Bell Telephone Company owned both sides of the interference that had been kept alive by its attorneys between Emile Berliner and Thomas A. Edison, but it was not so widely understood that the interference had been settled and a patent to the successful contestant was now delayed by an application filed in 1880 by Daniel Drawbaugh, the alleged Pennsylvania inventor, whose claims were sifted in the famous telephone suit before the United States Circuit Court. That case was one of the most important and interesting in the history of the tribunal that decided it. It was unique in the extraordinary character of the rebutting evidence and in the profound scientific questions involved in certain phases of the dispute.

The Drawbaugh application never was in formal interference with either Berliner or Edison, but its fate turned eventually on that law of practice in the Patent Office that dismisses any application for a patent on a device that has been in public use two years. Edison's carbon transmitter was finally shown, in the public use proceedings instituted in the Drawbaugh case, to have antedated the latter's application by more than two years. The Drawbaugh claims once thrown out of the Patent Office, the present Berliner patent was granted and issued. This patent as it stands embodies a strong claim on the principle of the microphone transmitter, to-day universally employed. The following extracts from the specification and claims give a sufficient idea of their scope:

"My invention consists in a new and useful improvement in transmitters for electrically transmitting sound of any kind, of which the following is a specification;

"It is a fact if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current the pressure between both sides of the contact becomes weakened the current passing becomes less intense, as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness, the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current.

"In Figures 1 and 2 of the drawings, *A* is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball *C*, terminating the screw-threaded rod *B*, which is supported by the bar or stand *d*. The pressure of the ball *C* against the plate *A* can be regulated by turning the rod *B*. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other.

"It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point The plate may be of any shape or size, or other suitable vibratory media may be used—a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the other sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation.

"I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing.

"1. I claim: The method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact, so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

"2. An electric speaking telephone transmitter operated by sound waves and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate."

Figs. 1 and 2 referred to in the specification are given herewith, and it will be seen that the mechanism actually shown employs only a single contact as the surface, the varying resistance of which produces the necessary electrical undulations upon the line in response to the human voice. The specification, however, states that there may be more than one such point of contact. The claims are far broader than anything distinctly shown in the specification and embody the method rather than any specific apparatus by which it is to be carried out. They are, in fact, almost as sweeping as that famous fifth claim of Alexander Graham Bell's basic patent which has been successfully held against every attempt to upset it.

Nevertheless, in the present state of the art this Berliner patent is far less wide-reaching in its influence than at first appears, and the consternation it has occasioned is not justified by the facts. Popular sentiment—always ready to resent any supposed infringement on public rights—has grown excited beyond all reason, and it is well now, therefore, calmly to sit down and look over the field, reviewing first the state of the art at the time Berliner's application entered the Patent Office, its remarkable and protracted career in that office, and finally, both its bearing on the art of telephony to-day and the various proceedings by which its fundamental importance may be very considerably decreased.

The inventor's own account of the progress of his work up to the time his caveat was filed on April 14, 1877, is given in another column. Twelve months before, the scientific world had been profoundly stirred by the report that Alexander Graham Bell had invented an instrument by which the transmission of articulate speech was successfully accomplished. No announcement in modern times aroused so much excitement and enthusiasm, for a possibility that had been only dimly foreshadowed in the great electrical researches of the past fifty years seemed to have been realized. Realized indeed it was, for a few months showed that Bell's claims were well founded, although his instruments were as yet crude and their performance imperfect. The same apparatus served both to transmit and to receive the electrical undulations necessary, and it was very soon found that the almost infinitesimal currents produced in the sending instrument were insufficient to produce audible sounds over any considerable distance.

Not only the original inventor, but many others who by nature or education were more or less fitted to cope with such a problem, undertook the task of improvement. It was evident from the outset that electrical undulations on a large scale must be produced in order to cause vibrations of sufficient amplitude in the distant receiver. Alexander Graham Bell himself obtained on Jan. 30, 1877, a patent for improvements in both sending and receiving instruments that covers pretty thoroughly most of the forms in use to-day, but this was not enough, for it was only an amplification of the apparatus already in use.

Elisha Gray, in his famous caveat filed on the same day with Bell's original application of Feb. 14, 1876, had suggested a means that might be made to give the requisite variations of current on a considerable scale; this was nothing less than producing by the vibration of the sensitive diaphragm variations in the position of the electrodes in a minute liquid rheostat; in other words, the production of electrical undulations by varying the resistance of the circuit through which a current was already flowing. This was the line of investigation which was destined to produce a successful transmitter.

On April 14, 1877, Emile Berliner filed his caveat for a transmitting telephone, in which an electric current was caused to vary by changes in pressure between two electrodes lightly in contact. Three days previously his first successful experiment had been tried. On the fourth of June he applied for a patent, and on July 20 Thomas A. Edison filed his application for a similar device, differing from Berliner's principally in that it specified the use of a contact piece of graphite instead of a metal ball, resting as before, however, against the centre of a metallic diaphragm.

An interference was soon declared between these two contestants, both of whom had been experimenting at about the same time, had hit upon the same successful principle and had claimed it broadly.

The fight promised to be a long one, the longer because Edison's patent was assigned to the Western Union Telegraph Company, fertile in resources and stubborn in litigation. It was evident that no broad claim could be obtained for a considerable time, and both Edison and Berliner soon made application for defensive patents covering special forms of apparatus. Two such were issued to Berliner on applications dated Oct. 14, 1877, and Jan. 15, 1878. Both these patents refer to the application of June 4, 1877, the offspring of which they were. A group of patents, four in number, was granted to Edison April 30, 1878, on various modifications of the transmitter, and on applications bearing date at various times in the latter part of 1877.

These are the patents which have controlled the forms of the transmitter used up to the present time. Modifications by other inventors were patented later, the most important of them being the group of patents to Francis Blake, dated Nov. 29, 1881, and the Hunnings patent granted Aug. 30, 1881. These improvements—subject to limitations on account of foreign patents—expire respectively Sept. 16, 1892, and Jan. 20, 1893, leaving, however, the Edison and Berliner patents still in active existence.

The original interference meanwhile has been slowly winding its way through the mazes of red tape in the Patent Office. Berliner's application was assigned to the American Bell Telephone Company May 21, 1881, and by the famous agreement between that organization and the Western Union Telegraph Company—called recently to mind by the suit instituted between the two—the Edison application was transferred to the same willing hands. Owning, then, both sides of an interference on the fundamental principle of the commercial transmitter, the telephone company took its own time about settling the question of priority between the two inventors. The longer the issue of a patent to either could be delayed the later would be the date assigned and the longer could be put off the day of reckoning in which the practical telephone apparatus would have to be given to public use.

Such a policy of procrastination had not been altogether unknown in the Patent Office in previous years, but in this case the interference dragged its slow length along for eight weary years, coming to its final adjudication and settlement in 1886, and even this was not the end. The Drawbaugh application for a microphonic transmitter entered the Patent Office in 1880, just at the time when the backers of Drawbaugh's claim were preparing to make a desperate fight against Bell's fundamental patent. They had everything to win, for by securing either the broad principle of the telephone, or its most important single modification in the transmitter, the Drawbaugh contingent would have had the game in their own hands.

Consequently they were in no greater hurry than the American Bell Telephone Company to push the transmitter claim to an issue, for if they won the principal fight they could force their opponents into a compromise, and if defeated there but successful in the transmitter claim, a patent issued at a very late date would be valuable either as a basis of negotiations or for independent use after March 7, 1893. The Drawbaugh claim, therefore, for one reason or another, was kept year after year in the Patent Office, the main question being all the while whether the Edison carbon transmitter had been in public use for two years before the Drawbaugh application, in which case the latter would be cast into outer darkness. The Berliner-Edison interference was settled, but still no patent could be issued, for under Patent Office procedure (however severely it may be criticised), such issue would be compelled to await the time when the Drawbaugh application should either be rejected or allowed to go into interference with the successful contestant in the former litigation.

Finally, after nearly a decade had elapsed, public use proceedings were brought by the direction of the Commissioner of Patents against this long standing application and it was finally and once for all thrown out of the office late in October of this year. The Berliner patent was then issued by order of the commissioner on the representation of Examiner Bissing that public policy demanded that it should no longer be retained in the office. This action was the more necessary as none of the foreign patents issued to Berliner were broad enough to in any way limit the present claim, as they were one and all patents on details, like those already issued in this country.

From this brief history of the case in hand it appears that while the Bell Telephone Company may have sinned in delaying, it was also sinned against. As it owned both sides of the Berliner-Edison interference there is every reason to believe that question to have been decided on its merits, and to

whomsover the application made might have been assigned, Emile Berliner was, under the laws of the United States, entitled to a patent for his invention. In so far forth justice was done, and that the issue of the patent has stirred up so extensive public disapproval and such general expressions of denunciation must be considered largely a matter of sentiment. Had the same claims been allowed on this Nov. 17 to Elisha Gray, for example, there would have been no anathemas, and in popular opinion it would have been the sweet revenge of time for that useless caveat of 1876. Popular hatred of a monopoly should not so cloud the judgment as to cause it to forget the rights secured by law to inventors.

And now that the Berliner patent is issued what will be its effect? At first thought it appeared to be complete control of all the commercial forms of telephone transmitter, thereby securing to the American Bell Telephone Company 17 years more of practical monopoly. Infringement suits will doubtless be instituted by the owners of the patents against users of such instruments, but they will have the advantage neither of the leniency of the courts toward the original inventor of an enormously useful appliance, nor the security of the almost entire absence of any previous "state of the art." On the contrary, public sentiment will be against the sustaining of any broad interpretation of the patent; the courts will look askance at the long delay in its issue, and telephonists will cast about for means of avoiding it. Litigation will doubtless ensue, but it is quite as likely to result in favor of the respondent as of the complainant.

Looking carefully over the ground it will be seen that if the Berliner patent in question is not to control the future of telephony it must be either—First, overthrown; second, its claims given so narrow an interpretation as to permit the use of commercial forms of microphone transmitter; third, practical apparatus rendered safe by Berliner's disclaimer can be devised; or, fourth, the patent must be avoided entirely by the use of transmitters other than microphonic.

Without stopping to examine the specification and claims exhaustively, two lines of attack on the validity of the patent at once present themselves. First, lack of invention; second, want of novelty.

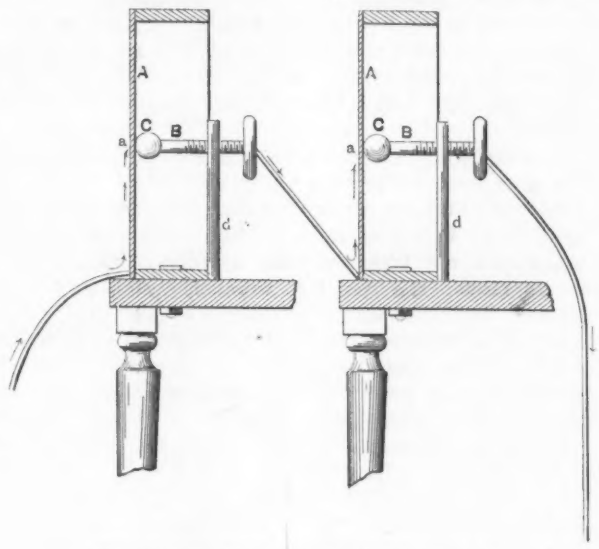
In the latter part of the year 1876, when Berliner by his own statement began his experiments, it was not new to produce electrical undulations, corresponding to the sound waves sent out by the human voice and able to transmit articulate speech, by means of varying the resistance of an electric circuit in which the current was flowing. Gray's water telephone, imperfect though it was, was already known, and inventors were at work devising modifications of it. In fact one of the group of patents issued to Edison on April 30, 1878, is for such a modification. Further, Berliner especially disclaims the general principle of variation of resistance. It was known long before 1877 that a variation of pressure between conducting surfaces would vary the resistance of the contact and hence any current which might be flowing through it. It was a fact known both in general and specifically, and indeed Clérac, of the French telegraph office, had, as early as 1866, employed a carbon rheostat in which variations of contact pressure produced variations of electrical resistance. There are other recorded cases of the same method having been used, and its general principle had been enunciated by Du Moncel in the following words: "The pressure exercised between two conducting bodies abutting against each other has a considerable influence on the strength of the current." The same phenomenon, as mentioned by Mr. Berliner, was known to telegraphers.

In view of the fact that it was more or less widely known that a variation in the resistance of the circuit carrying a current, and acted upon by the voice through suitable means, could produce electrical undulations able to transmit articulate speech, Berliner's device might be construed as merely the substitution of one known means of varying resistance for another known means—replacing the minute water rheostat of Gray's caveat by an equally minute pressure rheostat as suggested by Du Moncel and Clérac, and hence not constituting invention.

This is not at all a question that can be decided at first glance but it is one which must inevitably come up in the course of litigation. Second, granting that such substitution would have constituted invention, was there patentable novelty in the Berliner transmitter in view of the telephone constructed as early as 1864 by Philip Reis? That Reis' telephone could and did transmit articulate speech admits of no dispute at the present day. In more than one of the numerous forms of Reis' telephone a loose contact maintained only by gravity is disclosed and such a contact is quite capable of serving as a transmitter for articulate speech, as was found in the experiments with Reis' instrument, although its proper operation was often interrupted by indistinctness and rattling due to imperfect contact or rupture of contact. In Berliner's specification he distinctly states that if the uttered sound be too strong there will be just such a break and the tone will be loud but not distinct in articulation. Imperfectly as Reis may have understood the action of his telephone it did transmit spoken words, and the difficulty encountered was precisely that mentioned by Berliner. Edison in proceedings in the United States court specifically admitted that he was started on the line of investigation that led to the carbon telephone by having put into his hands a manuscript translation of a report on Reis' telephone. The Berliner patent and the original Bell stand on somewhat different ground with respect to this early Reis telephone. Alexander Graham Bell grasped the principle in its entirety and utilized it by highly original apparatus. The Bell telephone does not follow in logical sequence with the instruments of Reis; the Berliner transmitter does. A little extra tension put upon the regulating screw of Reis' transmitter will transform it into an instrument quite as effective as that described in the Berliner patent—a trifling loosening of the latter will make its action identical with the former. Reis frequently made such an adjustment and obtained articulate speech.

Hence a nice point both of equity and scientific judgment may be raised concerning the relation of the present patent to the researches of Reis, even though Berliner was ignorant of his predecessor's work and Reis' imperfect efforts had been put aside in favor of Bell's unique invention.

Supposing the Berliner patent to be held valid against both these lines of attack, it still remains to give its claims an interpretation broad enough to cover all the commercial forms of microphone transmitter. It is a debatable question at least whether some of those employing buttons of carbon under compression, granular carbon and the like, fall completely within the Berliner claims in view of his disclaimer, and it must be remembered that considering the public sentiment in the case the court in any litigation brought under this long delayed patent will not feel disposed to construe the claims as liberally as was done in the case of the original patent to Bell. There is, too, a possibility of commercial transmitters operating by varying resistance, and yet completely shielded by the disclaimer just mentioned. There are none such in practical operation, but it is not impossible that some might appear if they were rendered commercially necessary by the sustaining of the Berliner patent, and, finally, there is at least a possibility—perhaps a strong probability—of the improvement of the




BERLINER'S MICROPHONE TRANSMITTER.

electromagnetic transmitter, in fact the ordinary Bell receiver, to a point that will make it sucessful for commercial telephones.

During the period when every one was experimenting with telephones while the preliminary litigation was still in progress, it became generally known that the ordinary electromagnetic transmitter would perform very well indeed over short distances and for longer and longer distances as it was more and more perfect. The same fact has become very evident since the expiration of the fundamental Bell patent in England last December. The best commercial forms of receiver will operate successfully, particularly over metallic circuits, at a very considerable distance, and such instruments are in habitual use by linemen of the telephone companies in sending and receiving over distances even as great as 100 miles. The articulation is beautifully distinct, but generally not loud enough for general use. It is quite within the bounds of possibility then that even supposing the broadest possible interpretation to be put on the Berliner claims, their effect could be largely nullified so far as competitors of the American Bell Telephone Company are concerned by modifications of the ordinary receiver.

It will thus be seen that, striking as the Berliner patent just granted is, it is neither unassailable nor impossible to avoid; in fact, if the Bell Telephone Company depended on it alone after the expiration of its basic patents, its monopoly would be short lived; but as a matter of fact such is not the case, for that organization owns a very large number of exceedingly useful and important detail patents dated at various times within the last decade and covering so many points of practical exchange operation as to seriously embarrass competition.

Aside from this, it has the immense advantage given by elaborate plants, carefully planned methods, long experience and invaluable franchises; these alone are sufficient to render competition sufficiently difficult without the assistance of the patent which has stirred up so much ill-founded excitement and unconsidered comment during the past week.

## The Invention of the Microphone Transmitter.

BY EMILE BERLINER.

In December, 1876, when the news of a speaking telephone had barely penetrated into the gossip of common scientific chitchat, I commenced to experiment with the view of investigating the subject of transmitting speech over a wire. My time for doing this work was rather limited and my stock of apparatus consisted of an old fire alarm electromagnet, a battery which I gradually increased from one to three gravity cells, a compass, a magnet, a tuning fork and some insulated wire, out of which with the compass I constructed a galvanometer. It was not much of an outfit, but with investigators lack of sufficient apparatus is often an advantage in disguise.

Acoustics and electricity had been my favorite studies for some time, and there was no lack of ideas which might be brought to bear upon the subject before me.

A small tin funnel was covered with the membrane of a toy drum, a piece of iron was glued on the centre, the electromagnet was rigidly held in front of it, and there stood the Bell telephone receiver of the patent of 1876. When I connected the battery to the electromagnet and opened and closed the circuit by touching the wires the loud thumps which emanated from the membrane demonstrated to my satisfaction that I had constructed a veritable scientific apparatus. I did not have any other electromagnet which would enable me to also construct a magneto transmitter, and after including the tuning fork in the circuit and touching the vibrating prongs with the other wire and making the telephone sing out a musical tone I set to work to make a battery transmitter.

I was not familiar at the time with the Reis invention, and my theory of a musical telephone developed into another drum membrane, a piece of platinum glued to its centre for contact and a rigidly held screw in front of it, and for a time I amused myself and my friends with telephone concerts. Some time later on I got an induction coil and a Geissler tube, which I connected with the circuits, darkened the room where the audience sat, and the ghastly flashes from the tube accompanying the reproducer when singing were considered by many of them far more wonderful than the simple transmission of speech.

In the meantime I had become firmly convinced that if a singing contact could be so modified that a greater or lesser intimacy of contact would modify the current passing, such a modified contact would act similarly to a Bell magneto transmitter.

The nearest thought to accomplish it was increase and decrease of contact surfaces; next came the idea of successive addition of a number of contacts and batteries at each vibration; lastly the compression of acidulated blotting paper between two platinum facings. That these experiments gave no more satisfactory results at the time was undoubtedly due to the crudeness and imperfection of the animal membrane telephone receiver, for it was not until during the summer of 1878 that I procured two hand telephones to act as magneto receivers.

I have heretofore related how the simple solution of modifying the contact by pressure alone came about.

An operator at the fire alarm office here in Washington (Mr. Richards), in showing me how to operate the Morse key, insisted on my pressing harder for the purpose of making the sounder at the other end respond better. One of the reasons, he said, why "ladies are unfit for long line telegraph work is the fact that they don't press down the keys firmly enough." This hint made a deep impression on my mind and from that moment I knew that the principle of a battery transmitter was lying dormant in the resistance which a loose contact offers to the current.

Experiments to verify this conception immediately followed, but working with platinum contacts made the task extremely difficult. Broken lead pencil points were tried but soon abandoned on account of the high resistance they offered, and lastly common charcoal iron responded most successfully to increase and decrease of contact pressure and the galvanometer showed variations the best when the contact was very loose and unstable. My anxiety, however, centred in the query how far my invention was original. To my mind the fact which Mr. Richards had communicated was well known and I imagined that many other experimenters would naturally settle upon contact pressure as the principle to follow.

On the 11th day of April, 1877, however, an inciden occurred which filled me with more confidence in the orig inality of what I was doing.

It was late at night, and great quiet prevailed on the street and in the house. Before me, standing on one side, was a small wooden soap box with the original bottom removed, a speaking hole in the swinging lid and a rigid bar through the inside. The former bottom had been replaced by a plate of common black sheet iron and through the rigid bar was screwed a wood screw tipped with a polished steel dressed button touching the black sheet iron surface. The galvanometer was in position with the line and the battery, and in order to adjust the contact I tapped the wire end so as to find the adjustment when the galvanometer would swing back and indicate the circuit to be nearly open. Suddenly a faint tick became audible, increasing in loudness as I loosened the contact, and when nearly at a break the tick was very sharp, and accompanied by the rustling sound of the vibrating iron. After my surprise at this phenomenon was over, and having repeatedly gone over

the same experiment, I put the tuning fork into the circuit, and tapping one wire to its vibrating prongs a loud musical sound coming from the contact and the plate filled the room. I then thought that I had made an important discovery.

Two days later I rigged up another such soap box contact telephone, and songs, with their words, were successfully transmitted and received with the two instruments from the top floor to the basement of the house.

On the 14th of April I filed a caveat for this combination, and since then and by altering the sizes of the drawings and a proper electromotive force, most perfect articulation has been heard from these, the most simple electric telephones ever constructed.

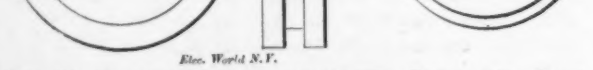
As time passed on I found that the real merit of the invention rested with its action on a transmitter, and my first dream—that of seeing it practically used independent of a magneto receiver—fell short of being realized.

## The Elements of Practical Electricity.*

BY DR. LOUIS BELL.

### THE CONSTRUCTION OF THE GALVANOMETER.

We have just seen how currents could be measured by deflecting a magnetized needle. It only remains now to construct the apparatus of such form as will be suited to accomplish our object conveniently. To this end the wire through which the currents are to pass must be held permanently in a fixed position with reference to a needle so fitted that its deflections can be easily measured.




Figs. 23, 24 and 25.—Galvanometer Ring and Base.

First let us make a supporting frame to carry the wire through which the current to be measured is to pass. This is best formed—for reasons which you will understand later—in the shape of a circle. Take a piece of half-inch hard wood board a little over a foot square, and from its centre strike with a pair of dividers two circles, one with a radius of six inches, the other with a radius of four and one-half inches. Saw carefully around these two circles. You will then have a ring just 12 inches in exterior diameter and nine inches in interior diameter, as shown in Fig. 23. Out of a somewhat larger piece of the same wood cut two similar rings of the same internal diameter, but six and one-half inches extreme radius instead of six, and fit these three rings carefully upon each other, as shown in Fig. 24, which gives an edge view of the combination. Glue them firmly together, turning the three rings so that their grain shall not run in the same direction in order that they may be tolerably secure against warping.

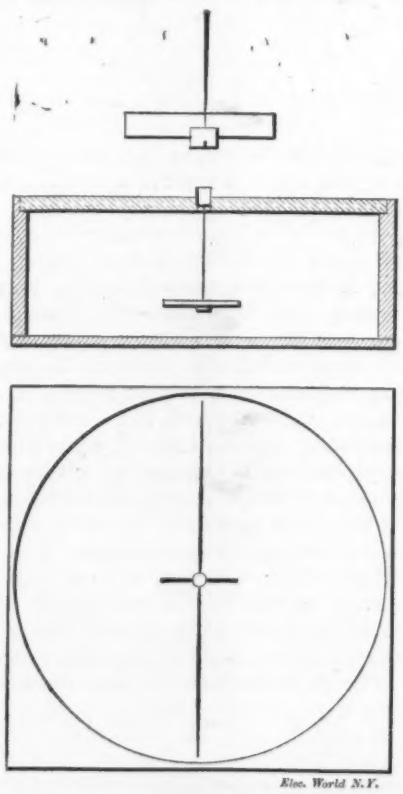
Keep them in press till the glue is thoroughly hardened, then finish up carefully, smoothing them with sandpaper and rasp until the whole is neatly finished and the inner circle is accurately round. Now, prepare a baseboard to support this ring, making it circular, of inch board, about eight inches in diameter, and bevel the edges by way of giving it a neater finish. Bore four quarter-inch holes through this baseboard, forming a square about five inches on the edge, as shown in Fig. 25, and fit into these holes large brass machine screws with blunt ends fitting tightly enough to cut light threads in the interior of the holes so that by turning the screws the baseboard can be leveled. All the wood used in the construction of this instrument should be thoroughly well seasoned so that it will not warp and throw the instrument out of plumb. Prepare also two blocks six inches long, two inches high and 1½ inches thick. The grain should run lengthwise of these and both should be planed up true and carefully fitted to the baseboard and ring so that when the ring is set up on edge over the centre of the baseboard the two blocks pushed up on either side of it and fastened there will hold it firmly in position. Do not put these several pieces together, however, for the present.

Now out of half-inch or, better yet, quarter-inch, stuff construct a square box five inches on a side and two inches deep—inside dimensions. This is to serve as a compass box, and must be fitted with a cover of very clear window glass which can be best kept in position by cutting away the inside of the box at the top all around, forming a square shoulder against which the glass can rest. (See Fig. 27.) Into the bottom of the box fit a piece of old looking-glass. Next the compass box must be provided with a graduated card on which the deflections of the needle can be read. If you are handy with draughting instruments you can readily make this of the required size on a card five inches square to fit the box, the north and south lines being placed accurately parallel to the sides of the box. Graduated circles of convenient size may be easily obtained from many dealers in draughting instruments and supplies, and if you can readily get one of these the box can be made for it; the diameter, however, of the graduated circle should be at least four inches; still better, five.

This circle should be fitted into the box over the looking-glass, but all the card except the exterior graduated ring should be carefully cut away so as to leave a circle of looking-glass with the graduations on the card about its edge. The purpose of the mirror is to enable you to tell when you are looking exactly down on the needle. Now comes the question of fitting your compass box with a needle, and this is rather a delicate matter both as regards the arrangement of the needle and pointer and the suspension of the whole.

Take a piece of thin spring steel about five-eighths of an inch long and an eighth of an inch wide, to form your needle. Just midway between its ends but a little nearer one edge of the steel than the other, punch or drill a minute hole, and to do this readily you must draw the temper of the steel by heating it over a gas jet and cooling it very slowly. If no convenient means for making this hole is at hand you can take a piece of extremely fine copper wire—No. 36, for example—take a single loop of it around the steel near its middle, twist it up tight and, then make another loop perhaps a sixteenth of an inch from the first, and on the other side of the middle point of the spring. The very minute loop of wire between these points of attachment and just outside of the spring will form a ready means of suspension. In either case hang the needle up by an exceedingly fine piece of sewing thread put through the hole of the loop, and file the ends until the needle hangs horizontally. Now harden it by heating and quenching in cold water very suddenly, and magnetize it thoroughly—either by putting it across the poles of a little electromagnet, or stroking it with any magnet that is convenient. You are now ready to provide it with a suitable pointer and you can easily understand that a short needle will not enable you to use a graduated circle as large as you ought, in order to have the graduations sufficiently fine. A long needle is objectionable for the reason that it is deflected out of the plane of the ring by the action of the wire that carries the current, its ends get perceptibly further from the current and it is less and less affected the further it swings out. In other words, the magnetic force exerted by the current upon it is not uniform, and hence the very simple law of tangents mentioned last week will not apply accurately unless the needle is very short compared with the diameter of the coil carrying the current. It will then be acted upon uniformly in every position because its ends will pass out of the plane of the wire by an amount almost imperceptibly small.

Five-eighths of an inch is quite long enough for a needle for a galvanometer with a 12-inch ring. You must therefore add to the needle a pointer, which should lie not parallel to it, but at right angles, for the reason that when you are trying to note deflections on the graduated circle, the pointer, were it parallel to the needle, would be within the wooden ring that carries the wire, and hence you would be unable to look directly down upon it. Therefore make a little saddle of cork, slit it and slip it on to the lower side of your needle, as shown in the little detail sketch, Fig. 26. The saddle can be fastened in position with a drop of shellac. Across




Figs. 26 and 27.—Galvanometer Needle; Plan and Section of Compass Box.

the bottom of this, at right angles to the needle, can be fastened the pointer by means of shellac or a minute drop of sealing wax.

The pointer itself requires care in its manufacture. A thin piece of copper, brass or aluminium wire makes an excellent pointer, but perhaps the most convenient material, strange to say, is glass.

Take a bit of the glass tube used in some of the previous experiments, perhaps four or five inches long, heat the middle of it very hot over a gas jet or a spirit lamp until it is thoroughly softened and begins to sag down toward the flame, then suddenly withdraw it, and holding the tube vertically pull the ends quickly apart. If this is neatly done you will have a thin and light hollow fibre of glass hardly bigger than No. 36 wire and perfectly straight. If the first trial does not produce this, heat one of the ends of the glass tube again, touch the heated end with another bit of tube, to which it will adhere readily, and then pull out another fibre as before. A few trials will enable you to get a straight glass fibre five or six inches long.

Break this to the proper length, just long enough to lap over a quarter of an inch on the divided circle, and then dip the ends in ink so that they will be readily visible against the white circle. Now fasten the pointer to the bottom of the little cork saddle exactly at right angles to the needle. Two lines drawn on paper crossing at exactly 90 degrees will enable you to make this adjustment with a good deal of accuracy. The pointer must in addition be exactly under the point from which the needle is suspended. You are now ready to assemble the galvanometer, but first the ring must be

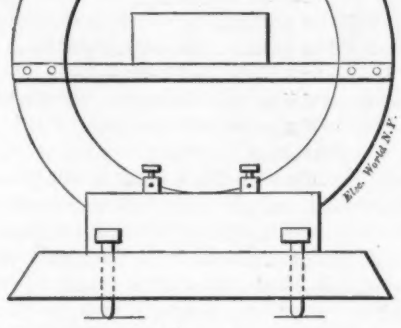



Fig. 28.—Completed Galvanometer.

wound with the wire which is to carry your current. For this purpose you had better use No. 16 double cotton wound magnet wire, about 70 feet in all. Punch with a bradawl a hole through one of the outer pieces that forms your galvanometer ring, just level with the bottom of the central groove, pass one end of your wire through this and then wind turn after turn of wire smoothly into the groove. It will hold about seven turns in a single layer, wind on three layers, and then, punching another hole close to the first, draw the end of the wire taut through it. You will then have 21 complete turns around your ring. Give the whole winding several good thorough coatings of thin shellac varnish and let it dry.

Then take the baseboard, put the galvanometer ring on edge exactly over its centre with the two loose ends of wire just far enough from the bottom of the ring to clear the two blocks which you have prepared, and which are to hold the ring in a vertical position, then glue or screw down the blocks against the ring, so that they will hold it firmly at right angles to the board. If screws are used they should be of brass in order not to exercise any magnetic effect on the needle. In one of the blocks an inch or so apart and directly at the bottom of the ring screw two binding posts, and after twisting the two ends of your galvanometer coil together from the point where they leave the ring nearly to the binding posts, separate their ends and solder them down to each binding post. By grasping your battery wires in the binding posts you will then be able to send the current around the entire 21 turns of the galvanometer. You are now ready to mount your compass box. It should be supported by two strips of half-inch stuff glued or screwed upon either side of the galvanometer ring at such a height that the centre of the ring will be just a quarter of an inch higher than the graduated circle at the bottom of the box. This will leave room enough for suspending your needle, and by close measuring you can make the adjustment very accurately. Screw or glue the supporting strips on either side of the ring horizontally, and at the proper height to bring the compass box to the point named. You may now suspend your needle, and put the compass box in permanent position. The first step is the difficult one. To drill a hole through the centre of the glass cover of the compass box is a somewhat careful task, but a few trials on broken glass will enable you to accomplish it.

The only tool required is a small rat tail file. Break off its end obliquely with a pair of pliers, then make a thin paste out of gum camphor and oil of turpentine, mark the exact centre of the glass by drawing its two diagonals, and daubing upon this spot a little of the paste, begin to cut with the broken end of your file, holding its cutting edge against the glass, and giving a slight circular motion to the wrist, as if you were attempting to scoop out a little bit of glass. Do not employ too much pressure in doing this, or you will run the risk of breakage. You will find the file bites quite readily and you will presently be able to work the hole clear through the glass. The latter part of the work requires a little care in order to avoid too much pressure. Smooth out the hole with the file, still lubricating with the camphor and turpentine paste, until it is about a quarter of an inch in diameter. Having done this you had better put your compass box in position, centring it as closely as possible and adjusting the east and west line

* Continued from The Electrical World of Nov. 21, 1891.

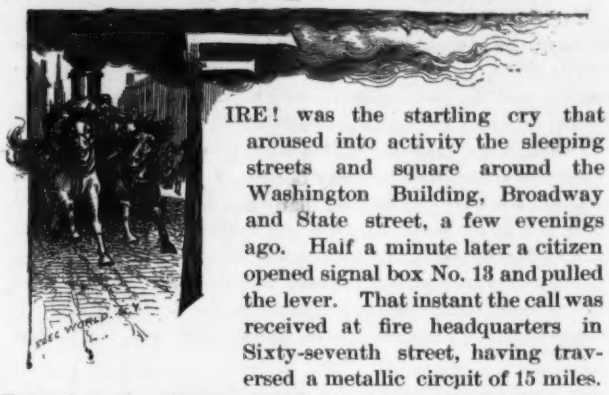
on the graduated circle perpendicular to the plane of the ring. A T-square will enable you to do this handily. Glue the compass box in position, and you are then ready to mount the needle. Pull out a few fine silk fibres from abit of silk floss, the finer the better, and tie one end of them through the loop or hole in your needle.

This can be best done with the aid of a pair of tweezers. Then pass the loose end—which should be a couple of inches long—through the hole in the glass, and taking a small cork stopper, such as will fit the hole, slit it lengthwise centrally, cutting perhaps two-thirds the way through, draw the end of the fibre into this slit in the cork and put the cork into the hole in the glass. Then lifting the glass you can place it in position on the compass box and will be able to draw up the fibre until the pointer just clears the graduated circle, Fig. 27. By moving it slightly in the slit in the cork you will be able to centre it very closely. As much of the convenience of using the galvanometer depends on the care with which this centring is done it is worth while to spend some little pains in getting the needle properly placed. The completed galvanometer is shown in Fig. 28. Set it up with the ring north and south, for it is in a north and south direction that the earth's magnetism acts. The magnetic needle itself will enable you to get the proper direction, since if the compass box has been carefully set and the needle is very closely at right angles to the pointer when the latter is 90 degrees of the graduated circle away from the ring, the ring itself will be closely in a north and south line. Level the base by means of the four screws and the aid of a level if you have one, and a T square if you have not. Now connect the poles of one of your battery cells with the tangent galvanometer you have just formed and a decided deflection of the needle will be produced. The exact amount you can read off by the change in position of the ends of the pointer on the graduated circle, looking down upon the compass box and getting the reflected image of the needle in the looking glass at the bottom of the box just under the needle itself.

Note the deflection of each end of the needle and then change the poles of your battery on the galvanometer binding posts. The needle will swing in the other direction and you can read the deflection of the needle in its new position. The angular deflections of each end of the needle in each position should be equal to each other; if they are not it is a sign either that your pointer is crooked or the needle not properly centred. Generally a few trials in centring the needle will bring the four deflections to equality, and it is worth while taking considerable pains in making this adjustment. You are now ready to try experiments where you can measure the relative strength of the various currents you are employing, instead of being obliged as before merely to guess at them.

*(To be continued.)*

## The Fire Alarm Service of New York City.



IRE! was the startling cry that aroused into activity the sleeping streets and square around the Washington Building, Broadway and State street, a few evenings ago. Half a minute later a citizen opened signal box No. 13 and pulled the lever. That instant the call was received at fire headquarters in Sixty-seventh street, having traversed a metallic circuit of 15 miles. From here the danger signal was automatically sent out over an additional 15 miles of metallic circuit to four engine companies, two hook and ladder companies, one water tower, and chiefs of the First and Second battalions, sounding simultaneously an alarm gong in each of the houses and releasing the horses. The nearest fire company to the call box being on Stone street, between Whitehall and Broad, this company was out of its house and under full speed for the fire within 23 seconds from the time the signal was rung, and at the fire 70 seconds later. By this one call every engine company in the city was also notified that a signal had been sent out from a call box, which in this instance is officially known as No. 13, and they put themselves in readiness to leave instantly, should a second or third alarm be sent in, as is very often the case.

This incident well illustrates the perfection of the fire alarm telegraph system of New York City, with headquarters in the Fire Department Building, No. 157 East Sixty-seventh street. The illustration shown on this page (Fig. 1), made from a photograph, gives a good idea of the operating room of what is probably the most perfect fire signal arrangement in the world.

On the left is shown the apparatus that controls the safety of the greatest city on the continent, while in the centre are seen instruments of the most interesting and intricate construction by which special calls and repetitions of regular signals are sent out, and recording devices, these forming a check on the regular circuits shown on the left.

In this one room, scarcely 50 feet square, is crowded the complete signaling apparatus of the department, which includes 1,186 call boxes and 1,500 miles of wire, 577 of which are underground. Fifty-three miles of cables are used for this underground service, and no appreciable trouble has been experienced. In all 200 circuits lead from all parts of the city between the Battery and the Yonkers city line to the central station.

By following a single alarm from the time it is rung at the call box until it reaches the engine company we can better understand the operation of this system. The call box attached to the new combination lamp-post is very extensively used. It is furnished with a keyless door, so that any citizen can open it in case of danger. A safeguard against false alarms is provided by a bell which rings in the neighborhood as soon as the door is opened, before the lever can be pulled down which gives the signal, thus attracting attention of policemen and others chancing to be in the vicinity. If the call is a genuine one, the citizen pulls down the lever, and by this one motion he starts five consecutive signals all alike; that is, if the call is from box 60, the signal "60" will be the one received at headquarters and repeated five times. The first call is confined to the station exclusively, and this simply indicates the circuit on which the call box is located and calls the operator to his post; if this call is on circuit No. 60 the indicator drop will so announce it. Beneath the circuit annunciator drop is a list of the call boxes on that circuit. By this arrangement the operator can tell at once when the signal is on the right circuit. If it is a correct alarm and not a cross with outside wires or other disturbance, he pulls down the handle which automatically signals both the engine and truck companies that are supposed to respond to the first call and at the same time rings a gong in every station in the city. At the same instant the call is automatically recorded on a continuous roll of paper by an elaborate system of relays. The action of the signal at the station is such that the gong is rung and the horses released.

In case it is necessary to send out the second or third alarm the foreman in charge of the fire telegraphs to headquarters by the regular Morse key system from the signal box. The relay and key at the central station will be seen in Fig. 2. Two sets of sounders are provided to guard against one being out of order. The operator, if he understands the message, signals back to the foreman, and immediately sends out the necessary call from the instruments in the centre of the room, which are practically a duplication of the main circuits we have described. By these telegraph instruments any call or combination of calls, bringing out one or all the fire companies of the city, can be dispatched instantly. It was from the large instrument to the left of the centre column that the famous "three-sixes" signal was sent out some years ago which resulted in the dismissal of Fire Chief McCabe, who was, however, afterward reinstated by order of the courts.

In case two signals should come in simultaneously over the same circuit, it would be impossible for the operator to get confused, for the reason that he cannot automatically send out the second until the first is completed. The call would come in as usual, but the second signals would have to be sent out by the other instruments, which can be done

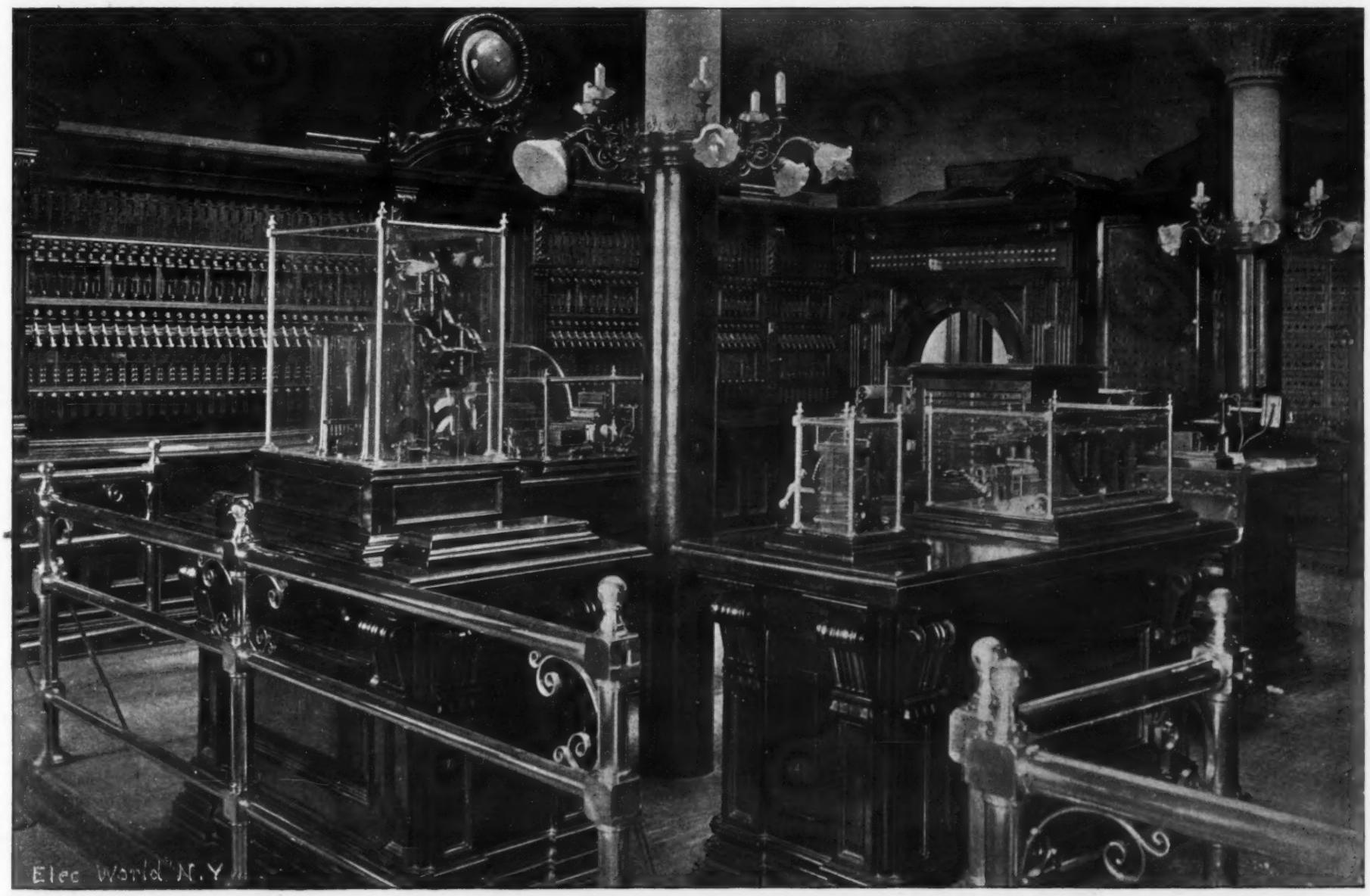



FIG. 1.—GENERAL VIEW OF THE FIRE ALARM HEADQUARTERS IN NEW YORK CITY.

almost as quickly as if the regular automatic apparatus were used.

While there is but one way of receiving the signals from the call box there are two of sending them out to the fire companies, and no conflagration could possibly leave the city at the mercy of the flames so far as signaling is concerned.

The switchboard of the system is especially interesting. It is situated at the rear of the room and is shown at the right in the illustration. Here are arranged all the measuring instruments necessary to ascertain the condition of the lines. Plug switches having four contact pieces are provided so that while the regular circuit is cut off for test an auxiliary one is thrown in, thereby insuring current at all times.

The combination instrument used at the engine house has features of novelty and value which have been designed by Superintendent Smith. This relay consists of a regular pair of magnets with divided armature. One part of the armature operates on the regular circuit which sounds the alarm and releases the horses, while the other is provided with a Morse key and set for a lower voltage. This is used for emergency calls and special signals. Over this weaker circuit what is known as the still alarm is transmitted. This alarm is given when the fire company leaves its house on a verbal call, which makes it necessary to notify the central office to be on the lookout for another company to take its place should the regular signal be rung for this company.

The battery room (Fig. 3) is located in the rear of the operating room. From 6 to 25 bluestone cells are provided for each circuit. A light current is always maintained in all the circuits, but when an alarm is given a set of batteries are thrown in by the operator by pulling the switch shown in Fig. 2. This is necessary in order to send the alarm automatically to all points of the city, but is not essential for ordinary work.

The main switchboard is directly back of the signaling room, and is 20 feet long by 7 feet high. Here the 200 and more circuits from the call boxes can be connected to any one of five wires by a screw plug.

In case it is necessary, the telephone wires of the city can be utilized to transmit all the signals of the service. The central station receives on an average one dozen alarms a day. Two operators are constantly on the platform during the night, while three are stationed there during the day.

The recent change from the overhead to the underground system, made necessary by the enforcement of the law relating to burying the wires, has so far been made without interrupting a single circuit or in any way interfering with the service.

As already stated, 53 miles of cable are used, and this was furnished by the Standard Underground Cable Company, of this city.

The instruments of the system, no doubt the most valuable and interesting set of electrical devices ever constructed

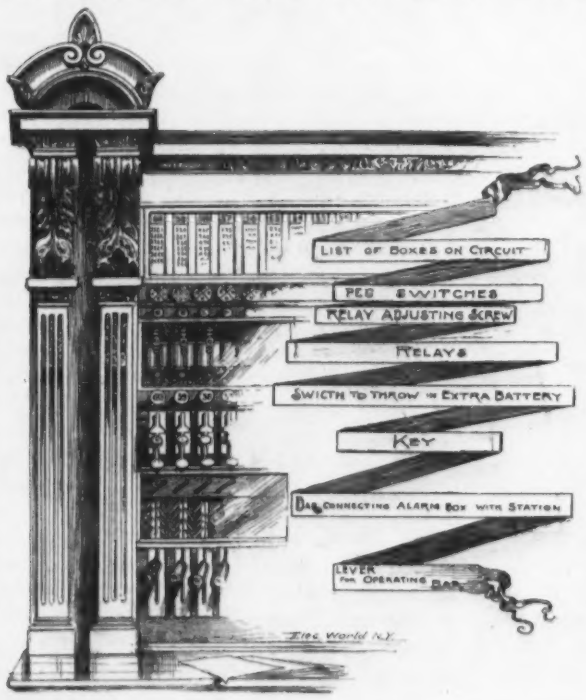



FIG. 2.—A CORNER OF A SWITCHBOARD.

for the purpose, were made by Messrs. Pearce & Jones, of this city, mostly after designs by and under the personal supervision of Superintendent Smith.

While it would be impossible in the limits of this article to describe these instruments it is only just to the combined genius of the designer and the makers to say that their product has never failed in the performance of its exceedingly important duty of protecting the city from the fire fiend. The instruments of the entire station form a most interesting group of electrical apparatus.

To Mr. J. Elliot Smith is due the credit for this unrivaled fire system. He has been connected with this department for the last 19 years and has succeeded in getting everything into shape after his own ideas. Mr. Smith is one of the oldest telegraphers in the country. During the war he participated in the capture of New Orleans, and during he first year of General Butler's rule in the Crescent City he was in charge of both the government and municipal telegraphs. Returning from the war he entered mercantile business only to take up telegraphy later.

Mr. Smith is ably assisted in the care and management of the system by Mr. George Farrell, his chief operator. Of the operating force upon whom such great responsibility rests in the constant watchfulness demanded, Mr. Smith declares them unapproachable in reliability.

Through the courtesy of Superintendent Smith, the New York Electrical Society was enabled to enjoy an unusual treat on the evening of Nov. 19. An invitation had been extended to the society, and a large delegation took advantage of the opportunity to inspect the fire headquarters. Superintendent Smith personally explained the workings of the system, concluding by sending in a signal from a neighboring call box, to which the engine and hook and

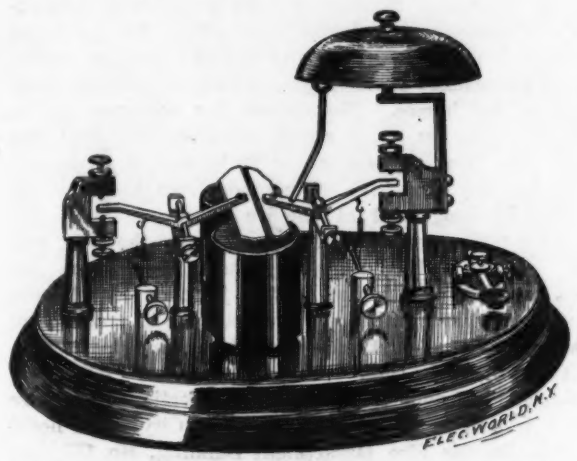



FIG. 4.—SPECIAL FIRE ALARM INSTRUMENT.

ladder companies responded with a promptness that left no room for doubt as to the efficiency of the system.

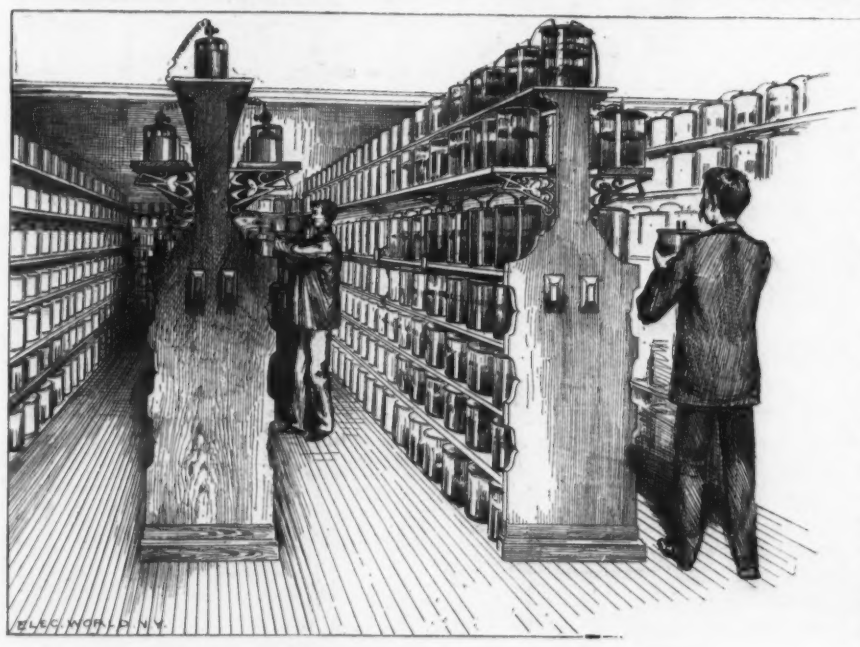



FIG. 3.—A VIEW IN THE BATTERY ROOM.

## A Motor Operating Automatically at Any Desired Speed or Torque and with Maximum Efficiency Under All Conditions.

BY H. WARD LEONARD.

In the operation of electric motors there are three principal factors to be considered—the speed, the torque and efficiency. Under any variations in power the efficiency should remain as nearly constant as possible. For one class of work it is desirable to keep the speed constant when the torque varies. For a second class of work it is desirable to keep the torque constant at one particular amount when the speed varies. For a third class it is desirable to operate at many different speeds, and yet automatically at any particular speed desired regardless of the torque. For a fourth class it is desirable to operate at many different torques and yet automatically at any desired torque regardless of the speed, and for a fifth kind it is desirable to keep the amount of power supplied constant, regardless of a change in torque, that is, so that if the torque changes by the requirements of practice, the speed would automatically change so that the power consumed would remain constant.

The shunt wound motor, operating on a constant potential circuit, is well adapted to the first class of work mentioned, where but one fixed speed is desired, practically regardless of the torque and with a practically constant efficiency.

The second class of work mentioned, having one particular constant torque and a speed variable at will, cannot be performed by existing electric motors without great sacrifice of efficiency. In this class of work we find hoists lifting a constant weight, certain printing presses, swing bridges, stamp mills, pumps, etc.; that is, such work as requires that we should start up from dead rest with full torque and run at any desired speed with the same torque and with perfect efficiency.

The third and fourth classes of work are more common than would at first appear evident, but since neither the steam engine nor the water-wheel can be operated under conditions where both speed and torque will vary, and where the speed or torque can be held automatically fixed at any point desired, regardless of variation of the other, we do not find work of this kind existing in such shape as to be operated by an electric motor instead of some other power. Nor has the electric motor been available for such duty heretofore. A familiar instance of the third kind of work is met with in the printing of fabrics, where the presses have a large number of rolls upon which the torque depends, and the speed of the presses must be varied as desired, and yet at any given speed must hold that speed constantly, regardless of the number of rolls set down, that is, regardless of the torque. Similarly, lathes, drill presses, wood-working machinery, etc., belong to this class. Certain variations in the speed are possible by existing methods by the use of the cone pulleys and equivalent devices, but no motor of any kind has heretofore existed which, directly applied, could conform to the requirements of this kind of work.

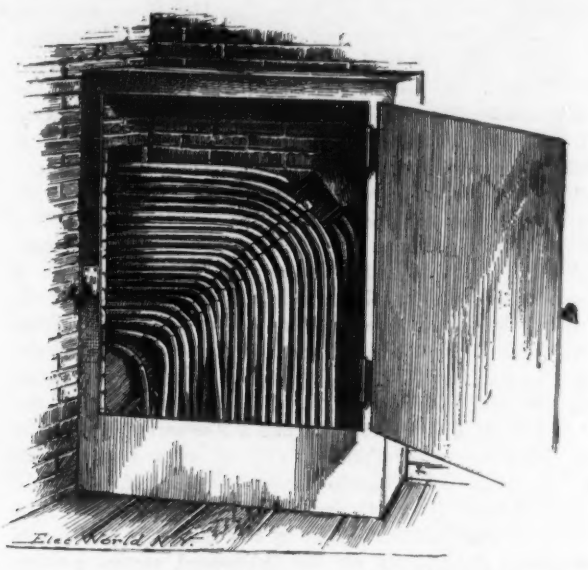



FIG. 5.—A CORNER OF THE CABLE BOX.

The fourth kind of work has, as a familiar example, the passenger elevator, where the weight, and consequently the torque is variable, and where at any torque the speed should be controllable at will, with constant efficiency. Another example is the pumping of water against a variable pressure with the speed controllable at will, and independent of the pressure. This result is not obtained directly by any motor to-day.

The fifth class of work, where the speed is automatically varied to keep the power consumed constant, no matter how the torque varies, is not met with in practice as far as I know, yet oftentimes we may have a constant source of power from which we wish to get a torque variable to the requirements of a variable load and do not care particularly about the speed. An electric street railway operated by water power is a familiar example of this class of work.

It will be seen from the above that of the five principal classes of work there is only one, namely, constant speed and variable torque, which we can take care of with reasonable efficiency and from our existing supply circuits.

It is well known that when a street car is first started and is scarcely in motion the actual power represented by such motion is almost nothing, for, although the pounds pull is large, the feet per minute is extremely small; consequently the power required must be exceedingly small. What do we find in practice? We find that in order to develop a power of but a fraction of a horse power we must, on account of the slow speed demanded, develop about 30 h. p., and then waste about 98 per cent. of this h. p. in order to utilize the remaining 2 per cent. in the way it is desired. The efficiency of the modern electric street car is not probably more than 2 per cent. when just starting from dead rest and moving at the rate of one-half foot per second.

When we come to investigate this, we find that the explanation is that in order to get the necessary large torque with freedom from excessive sparking, we must have a very large current in a nearly constant field; and since our E. M. F. is constant, we must use an amount of power which will vary almost directly with the torque, and will be regardless of the speed. Or, in other words, the efficiency of the motor will vary directly as the speed, with an efficiency of perhaps 80 per cent. at full speed.

As a result of my investigation of this subject, I have concluded that the operation of electric motors should conform to what apparently is a new law, and which may be stated as follows:

Vary the voltage as the speed desired.

Vary the ampères as the torque required.

In other words, make the speed dependent upon the voltage only and independent of the current, and make the torque dependent upon the current only, and independent of the voltage. Since the product of the speed and torque represents the work being done, and the product of the volts and ampères represents the power supplied, it is evident that if we can operate in conformity to this law, we shall have a constant efficiency under all conditions, disregarding, of course, the small fixed losses in the field and armature.

One way in which this law can be followed is to supply the field of the motor from one source of electric energy and supply the armature from another source, the E. M. F. of which can be varied. It will be noticed that when the speed is fixed a fixed voltage will be necessary in order to conform to the law, and the shunt motor is found to conform perfectly to the law; but it is the only motor I know of which does conform to the law which seems to be generally applicable.

A simple case will be the operation of a printing press for printing fabrics. Suppose the press has 10 rolls—that is, the torque will vary from one to 10 in amount. Suppose also that it must be run at any speed from that represented by one to that represented by 20, and at any speed it must hold its speed constantly, whether one or 10, or any intermediate number of rolls be brought into use. Also that the efficiency must be independent of the speed or torque. In order to conform to the law in a simple way, we will install a generator and motor of the same size and connect their armatures by two conductors. We will supply their fields from a small separate exciter in the shape of a shunt-wound dynamo. In the circuit leading to the field of the generator we will place a rheostat. If now we drive our generator at a constant speed, the E. M. F. it will produce will depend upon its field, which in turn will depend upon the amount of resistance in the rheostat in its field circuits. The strength of the motor field is constant, being supplied by the constant E. M. F. exciter. Now, evidently the speed of the motor will depend solely upon the E. M. F. supplied to its brushes, and this can be varied from 0 to the maximum limit by varying the rheostat, which will preferably be placed beside the motor itself. The current will automatically vary in proportion to the torque, the speed will vary directly as the voltage and the efficiency will be constant and independent of the speed or torque.

If we wish to operate an elevator from central station conductors of constant E. M. F., we supply a shunt-wound motor mechanically connected directly with a generator, whose armature is connected to the armature of the elevator motor. The field of the generator is supplied from the central station conductors, but a loop goes up to the elevator car, where a rheostat and reversing switch are placed, so that the E. M. F. of the generator can be varied and reversed at will. The field of the elevator motor is excited from the line constantly.

It will be evident that we can control the elevator perfectly from the car and run in either direction, at any desired speed, and with perfect efficiency. It is worthy of notice that the non-sparking point is entirely independent of the speed, and that for any particular weight the non-sparking point is absolutely fixed and independent of the power used. Also that, since the maximum weight alone determines the maximum ampères, it will be impossible to send more than the normal full load in ampères through the armature; consequently the liability of burning out of armatures is reduced to a minimum. The elevator in coming down generates current to assist the central station, and since the efficiency is practically constant under all conditions, and since as many foot-pounds of work are done by the elevator in descending as it requires in ascending, the consumer will in reality pay only for the energy wasted in charging the fields, in heating the armatures, and that represented by the friction of the gearing, which will be the least possible. The starting up of the elevator requires a minimum of power, and hence does not subject the central station to large, sudden fluctuations of load.

Suppose we want to operate a swing bridge by an electric motor. We connect, as in the case of a printing press, but instead of a hand field rheostat we use an automatic field rheostat, such as is used by the Edison company. We place an ampèremeter in the armature circuit of our motor, and when the ampèremeter needle indicates full load it touches a contact leading to the relay magnets of the automatic rheostat, which causes it to throw in resistance in the field circuit of the generator and reduces its E. M. F. Similarly, just below full load, the ampèremeter needle makes contact, closing a circuit in the automatic rheostat so as to throw out resistance and raise the E. M. F. of the generator.

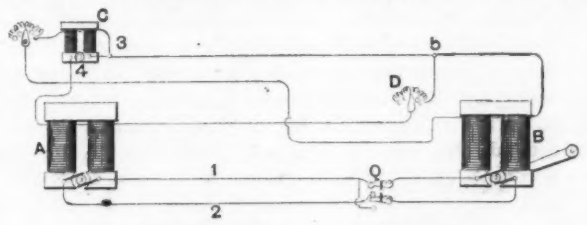
To start up the bridge we insert all of our resistance in the field of the generator and have, let us say, no volts. Now we close the main line switch to the motor; we will have no current; hence the ampèremeter needle will be on the lower contact, which will gradually throw out resistance and cause the generator to generate an E. M. F. The current will increase, and will finally cause the needle to leave the lower contact. The full torque is now being developed, and the bridge, if the motor be of proper size, will start to move. As it does so the counter E. M. F. of the motor will tend to reduce the current, but this will cause the needle to again make the lower contact and raise the E. M. F. and speed and hold the current and torque constant.

Thus the bridge will start from rest with a minimum of power but full torque, and will gradually accelerate in speed until the full E. M. F. and speed of the motor is reached. To vary the speed by hand we merely move the ampèremeter needle to make either contact desired. In case the bridge should meet an obstruction which would slow it down, the ampères would not increase, but would remain constant, as the volts would be immediately and automatically reduced to just that amount necessary to keep the ampères constant. With this arrangement it will be practically impossible to overload the motor armature.

Another good application of this method of keeping the torque constant will be in any case where a tool is cutting certain material which may vary in hardness, or when the feed may vary. If the torque be kept constant it will be impossible to break the cutting tool or injure the apparatus. An electric coal cutter is a case in point. The cutter may be advancing through slate, fire clay or coal, and occasionally it will meet a layer of hard iron pyrites, known in the mines as "sulphur." This may stop the cutter-bar entirely, and with an ordinary or series or shunt motor the result would probably be a burnt out armature. With the system I have described the current would be constant in any event, and the cutter would automatically go faster in soft material and slower in hard material.

In pumping by an electric motor operated on this system the head alone determines the torque, and hence the current. Consequently, for any lift the non-sparking point will be fixed and the number of strokes per minute can be controlled at will from 0 up to the maximum by varying the volts.

For operating an electric railway we will place a shunt-wound motor on the car, and directly driven by this motor will be a special generator, which will be connected to the electric motor below the car. It is evident that the generator and working motor armatures may be wound for any voltage desired, say 20 volts, which will make the problem of insulating the street-car motor an extremely simple one. If desirable, we can supply several cars of a common train from one special generator on the forward car. With this




LEONARD'S AUTOMATIC MOTOR.

outfit we will be able to take any car up any practicable grade or around any curve with no more power than is required to move the car on a level, and always consume the same power, regardless of weight, grades or curves. That is, the automatic increase of current, to take care of any increased torque, will be compensated for by a corresponding decrease in the volts and speed. We may start a car up on any grade or curve with but a small fraction of the power required for normal speed on a level.

I wish to call attention to a very important development leading out from this, namely, that we will be able to use alternating currents for operating our street cars, for it is well known that the ordinary alternating current generators will operate perfectly as motors, if the speed and torque be kept constant. Since by this system we can, from a constant torque and speed, get any other torque and, automatically, a corresponding speed, we shall be able to run street cars perfectly by alternating currents. This again will enable us to dispense with trolleys, conduits, storage batteries, etc. We will place between our tracks, in manholes, converters whose primary pressure can be anything required for proper economy and whose secondary will be say, 15 volts. This secondary circuit will connect directly with the rails. The road will be divided in sections, each a few hundred feet long, and each section will be supplied by its own converter.

This system also lends itself very readily to the transmission of power. We may transmit by alternating currents, and the alternating current motor running at a constant speed and at a nearly constant torque will drive special generators to operate hoists, pumps, locomotives, etc., at the varying torques and speeds demanded by practice, and yet without subjecting the alternating current motor to a sudden or wide fluctuation in its torque and without any necessity of varying its speed. With this system of operating electric motors there seems to be no work met with in practice which cannot be perfectly performed.

On first consideration, the additional apparatus necessary would seem to make the system prohibitory in practice; but the capacity of the present single motor is greater than the combined capacity of the apparatus this system would require, and the capacity of the prime motor is very much reduced.

In order to reduce the first cost to a minimum and yet secure the advantages of different automatic speeds and high efficiency, I have devised two modifications of the arrangement described above. The first is adapted to power in which a smooth, efficient acceleration of a load from rest is required, as in the case of passenger locomotives and elevators. The second case is where various automatic speeds are desired, but no especial importance attaches to the starting of the load from rest, as is the case in machinery in general.

For the first case we have the trolley system of electric street cars as the most important. Let us suppose we have two motors of 15 h. p. each for the car. We find that for full speed upon a level we require about 15 ampères at 500 volts. Upon heavy grades we find that about 30 ampères are required, and, as before, we have 500 volts. With this consumption of energy we find that we get a speed upon the heavy grade which is about one-quarter of the speed upon a level. In order to operate upon my system, let us place upon the car a motor generator, the motor part of which is wound for 500 volts and 12½ ampères and the generator part of which is wound for 125 volts and 30 ampères. The fields of the motor and generator part are distinct, and are wound for 500 volts, as are the fields of the two propelling motors under the car. All these fields are supplied from the 500-volt trolley circuit. In the field of the auxiliary generator is placed a rheostat.

Now, suppose the car at rest upon a grade. The motor generator is running, but the generator has a very weak field. Its armature is connected by a controlling switch to the propelling motors. We now gradually cut out resistance from the generator field circuit, and finally get about 20 volts at the brushes of the generator With this E. M. F. we get sufficient current to produce 30 ampères through the armatures of the propelling motors in a saturated field. This gives us the full torque, and the car starts at a speed of perhaps half a foot a second. This speed can be maintained constantly and indefinitely, and the consumption of energy will be less than two h. p. This is less than three ampères from the trolley line. In practice, however, the speed will be rapidly but gradually accelerated, until we have 125 volts upon the terminals of the propelling motors. We will now be running at one-quarter speed, and will be consuming 125 volts and 30 ampères, that is, 6¼ k. w. instead of 25 k. w. to get the same result with existing motors. To put it another way, we will not be using as much energy as is represented by the 500 volts and 15 ampères necessary for full speed on a level.

The next step on the controlling switch will disconnect the armatures of the propelling motors from the auxiliary generator and put the two armatures in series across the trolley line direct. We will now go at a speed represented by 250 volts, that is, one-half full speed. The next step of our switch will place the two armatures in multiple across the 500 volts, and the next and last step will place the 120-volt auxiliary generator in series with the main central station generators and give us 625 volts on our armatures and a correspondingly increased speed. We will be able to go up a grade of six to eight per cent. at full speed, with 30 ampères and 500 volts, which, with the present motors, gives only about one-quarter of that speed.

Under this arrangement it will be noticed that the only apparatus which could be called additional is the small motor of 500 volts for the generator part of our motor generator, which is useful, not only for starting, but for full speed also. In stopping the car we have an electric brake action delivering back energy to the line at full efficiency and not through a rheostat, as at present.

If we have a train of, say three cars, so that we have six motors, we can start from rest with sufficient smoothness by placing all six armatures in series, which will give us something less than one-sixth speed as the first step. Then we can place three in series with two multiples, which gives us one-third speed. Next, two in series with three multiples, which gives us one-half speed; and finally, all in multiple, which gives us full speed. Under such conditions, we can dispense with the small converting plant altogether.

For an elevator requiring, say, 15 h. p. we will put in a motor generator of 3 h. p., with which we will control the starting and stopping and the operation up to one-fifth of full speed. Then for full speed we will connect direct to the line and operate without any conversion of energy.

For power in which smoothness of motion in starting and stopping is not essential I have devised a new system of distribution, as follows: Three dynamos, all having the same current capacity and having voltages of 62½, 125 and 250 respectively, are placed in series and from conductors led off in multiple, one from each terminal of the machines. These conductors will have potentials which can be represented by 0, 62½, 187½ and 437½. Let us now take a shunt-wound motor, and, disconnecting the field from the armature circuit, excite the field from the outside two of the four conductors, that is, by an E. M. F. of 437½ volts. By connecting the armature terminals to the four conductors in various ways we shall be able to operate in either direction at six different automatic speeds represented by the following voltages: 62½, 125, 187½, 250, 275, 437½. By varying the field strength of the motor we can, if required, get any intermediate speed.

In many cases two dynamos will answer, one of, say, 110 volts already in use for incandescent lighting, and a second of, say, 30 volts. With this arrangement we could run in either direction and with automatic speeds represented by 30, 110 and 140.

With the four-wire six-voltage system of distribution in a shop we can take out all countershafting, belting, pulleys

and gears, if desired, and place a motor upon every tool, which we can operate in either direction at any automatic speed desired. Lathes, planers and all tools can be perfectly operated, and by getting rid of all countershafts and belts we can introduce the greatest of modern tools, the traveling crane, which we will also operate from our general system. We can also readily operate ventilating fans, hoists, elevators and factory tramways from the system.

The addition of one dynamo and one new conductor to any existing three-wire system will probably give all the flexibility required to meet practical conditions of varying speeds. For the alternating system a synchronous motor driving our three continuous current generators will give us the four-wire system in any distant factory or town. For 500-volt street railway circuits a small motor generator plant for the slow speeds and a direct connection for full speeds will give us perfect results. For storage battery work we have the most perfect condition, as we can get any E. M. F. desired, with a corresponding speed while keeping the field separately excited.

Now that we have the rotary field at command, I think I may safely assert that the time is not far distant when we shall have transformers which will, without motion, convert an alternating current in the primary into a continuous in the secondary; and this seems to me to be the ideal system of the future—that is, one in which enery will be transmitted by alternating currents of constant E. M. F. transformed without motion into continuous currents for use at the translating devices and used where motors are concerned in conformity with the law of efficiency for motors: Vary the voltage as the speed desired; vary the ampères as the torque required.

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## Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1783.——Saussure (Horace-Benedict de), professor of physics at the University of Geneva and founder of the Society for the advancement of the Arts in the same city, is the inventor of an electrometer designed to ascertain the electrical state of the atmosphere, which will be found described at page 619, vol. VIII. of the 1855 "Encycl. Britannica."

He observed that electricity is strongest in the open air, that it is weak in streets, under trees, etc., and that during the summer and winter, by night as well as by day, when the atmosphere is free from clouds, the electricity of the air is always positive. On the other hand, Mr. T. Ronayne found that in Ireland the electricity of the atmosphere is positive in winter when the air is clear, but that it diminishes in frosty or foggy weather and that he could detect no electricity in the air during summer except on the approach of fogs, when the electricity proved to be positive.

During the year 1785, Mr. de Saussure observed at Geneva that, during the winter, the intensity of atmospherical electricity attained its first maximum at 9 A. M., diminishing from that hour until it reached its minimum at 6 P. M., after which it began to increase until attaining its second maximum at 8 P. M., diminishing gradually thereafter till it recorded its second minimum at 6 A. M. During the summer he found the electricity increasing from sunrise till between 3 and 4 P. M., when it would reach its maximum; after that it appeared to diminish till the dew fell when it again became stronger, but was scarcely sensible during the night. Sir David Brewster informs us in his able article on "Electricity" in the "Britannica" that De Saussure made a number of elaborate experiments on the electricity of evaporation and combustion. He observed at first that the electricity was sometimes positive and sometimes negative when water was evaporated from a heated crucible, but in his subsequent trials he found it to be always positive in an iron and in a copper crucible. In a silver and in a porcelain cruciblethe electricity was negative. The evaporation of alcohol and of ether in a silver crucible also gave negative electricity. Mr. de Saussure made many fruitless attempts to obtain electricity from combustion, and he likewise failed in his efforts to procure it from evaporation without ebullition.

To De Saussure is often erroneously attributed the authorship of Lullin's "Dissertatio physica de electricitate," alluded to at A. D. 1766.

See De Saussure's "Dissertatio de Igne," "Exposition abrégée, etc.," (translated by Giuseppe Toaldo, in both his "Della maniera, etc.," and "Dei conduttori, etc.," Venezzia, 1772 and 1778), "Voyage dans les Alpes," all published at Geneva, 1759, 1771, 1779, also the important 1786 Neuchatel edition of the last named work, more particularly at pages 194, 197, 203, 205, 206, 211, 212, 216, 218, 219, 228, 252, 254 of vol. II., and at pages 197, 257 of vol. IV., likewise his Memoirs relative to the electricity of the atmosphere, of vegetables, of microscopic animals, etc., etc., alluded to in *Journal de Physique* for 1773, 1784, 1788, in *Journal de Paris* for 1784, 1785, in vol. I. of Lazaro Spallanzani's "Opuscoli di fisica, etc.," for 1776, in vol. III. of the "Opuscoli Scelti di Milano," and in the *Philosophical Transactions*. See also Jean Sennebier, "Mémoire historique, etc.," Genève, 1801; Louis Cotte in his "Traité, etc.," "Mémoires, etc.," "Observation, etc.," Paris, 1762, 1769, 1772; in the "Mémoires de Paris," Année 1769; Hist., p. 19, Année 1772; Hist., p. 16, and in the *Journal de Physique* for 1783, vol. XXIII.; the experiments of MM. Becquerel and Breschet in Becquerel's "Traité d'El. et de Magn." Paris, 1836, vol. IV., p. 110; Theodor Ægidius von Heller, "Beobach d. Atmosphär Elektricität" (F. A. C. Gren, "Neues Journal der Physik for 1797, vol. IV.); Faujas de St. Fond, "Description, etc.," vol. II., p. 271, as per George Adams' "Essay on Electricity," London, 1799, p. 419; Noad, "Manual, etc.," London, 1859, p. 16; Poggendorff, vol. II., p. 755; Rozier, XXXI., 317, 374, XXXIV., 161; articles "Meteorology and Electricity" in the "Encyclopædia Britannica;" Thomas Young, "Course of Lectures, etc.," London, 1807, vol. II., pp. 477, 466–471.

A. D. 1784——Swinden (Jan Hendrik Van), who had been made professor in the University of Franeguer at the early age of twenty (1767), and was at this time occupying the Chair of Natural Philosophy and Mathematics at Amsterdam, publishes in three volumes, at La Haye, his "Recueil de Mémoires sur l'Analogie de l'Electricité et du Magnétisme, etc." ("De Analogia . . . ." in vol. II. of the "Neue Abhandl. der Baierischen Akad. Phil.") The latter contains all the essays sent to the Electoral Academy of Bavaria on the subject—"Is There a Real and Physical Analogy Between Electric and Magnetic Forces; and, if Such Analogy Exist, in What Manner Do These Forces Act Upon the Animal Body?"

Van Swinden's essay, which gained him one of the prizes, shows that, in his opinion, the similarity between electricity and magnetism amounts merely to an apparent resemblance, and does not constitute a real physical analogy; whence he infers that these two powers are essentially different and distinct from one another. The opposite opinion was maintained by Profs. Steiglehuer and Hubner, who contended that so close an analogy as that exhibited by these two classes of phenomena indicated the effects of a single agent, varied only in consequence of a diversity of circumstances.

The eminent professor, Gerard Moll, of Utrecht, has communicated to the Edinburgh *Journal of Science* (1826, vol. I., part II., pp. 197–208) a biographical notice of Van Swinden, wherein he gives a list of the latter's principal works and there speaks of one of his best known productions: "The *Positiones Physicæ* (Opusc. Scelti, X., 7), as far as they are published (Harderovici, 1786, vol. I. and vol. II., part I.), are allowed to rank among the best elements of natural philosophy, and have been found by actual experience to belong to the best sources from which the young student could draw his information on those parts of natural philosophy, and its general principles, as are contained in the first volume and part of the second, which is all that was published. The work itself is on a most extensive plan; and the multifarious avocations which crowded on Van Swinden in Amsterdam delayed the publications, and made him afterward abandon all thoughts of completing a work which would have done the greatest honor to its author, and which even now, unfinished as it is, is celebrated as an excellent specimen of sound reasoning and profound learning."

Van Swinden was the first president of the Royal Institute of the Netherlands. He entered with ardor into all the new discoveries of his day and kept up an extensive correspondence with many of the leading scientific characters of the time, notably with the Swiss scientist, Charles Bonnet (whose "Contemplations de la Nature" he annotated extensively); and with Dr. Matthew Maty (who became secretary of the Royal Society upon the resignation of Dr. Birch in 1765.

* Continued from The Electrical World of Nov. 21, 1891.

## Electricity in Mining.—I.

In the following articles it is proposed not only to give briefly the theory and principles involved in the practical application of electricity to mining machinery, but also a review of what has actually been accomplished in this field.

While some of the features to be treated may have already received attention in the electrical journals, it is believed that a review of the entire subject in all its bearings cannot fail to be of interest at this time, when the mining world is looking to electricity as an agent destined to bring manifold advantages, and electrical companies are making great efforts to perfect their apparatus.

In mining work, perhaps, more than in any other of its numerous applications, do the superior advantages of electricity as a motive power and light-producing medium become manifest. In localities where nature has stored her richest treasures, she has, strange though it may seem, interposed serious obstacles to their being utilized for the benefit of mankind. Where fuel is scarce and transportation high, making the use of steam power unprofitable; in places where water power would be serviceable did not insurmountable grades or expensive tunneling prevent its adoption, are to be found some of the most extensive and valuable mineral deposits. It is not surprising, then, that in the past many mines of great promise have been abandoned because of the lack of a practical and economical method for long distance transmission of power insuring efficiency and commercial success.

With the development of the electric transmission of power, however, a great change has taken place. The electrical engineer and the inventor, after witnessing the complete success of electric lighting and a very general adoption of the electric motor for various power purposes, turned their attention to mining work. The accompanying scheme will indicate roughly to what an extent electrical apparatus is now being applied to mining processes, while new types and modifications of older forms are continually coming to the front.

- Initial power
  - Miscellaneous
    - Ventilation,
    - Pumping,
    - Lighting,
    - Signaling.
  - Transportation
    - Sub-surface haulage,
    - Hoisting,
    - Surface transportation.
  - Prospecting drills.
  - Excavating
    - Undercutting,
    - Drilling,
    - Channeling,
    - Firing blasts.
  - Treating
    - Crushing,
    - Pulverizing,
    - Separating,
    - Clearing.

It is proposed to give here a rough outline showing some of these applications of electricity as actually employed in mining engineering. Already there have been remarkable results in opening up new mineral fields, and increasing the value of those now known. The future is almost limitless, and when the natural prejudice against innovations in mining shall have been changed to a full realization of its many advantages, the entire engineering field will have undergone a change, the benefit of which can scarcely now be realized.

### ELECTRICAL TRANSMISSION OF POWER.

The distance over which electrical currents can be economically transmitted varies of course with local conditions; but roughly stated, in most parts of the United States the total running expense of transmitting large amounts of power from water privileges, by electrical means, is less than the cost of fuel for generating the same within distances at which other methods would be practicable.

The use of compressed air is one of the favorite methods of applying power in mining operations at the present time. In Michigan an extensive plant of this kind is in use, which transmits 500 h. p. of energy from a waterfall to a mine 3 miles distant. The plant has cost $400,000, for an effective supply of 175 h. p. at the mine.

With a good electrical system of power transmission, 60 instead of 35 per cent. of the energy of the water power would be delivered at the mine at an expense of not over $75,000 for the electric plant, and the cost of maintenance would be very much less than that of the compressor plant.

Added to this great waste in power there is another very serious objection to the use of air transmission from the possibility of the exhaust parts of drills, pumps and engines becoming frozen. To prevent this interruption from snow and ice heat often has to be applied externally. The use of this remedy is accompanied with great expense and inconvenience.

Compared with any other known means the electrical transmission of power has immense economical advantages, to say nothing of the great superiority in its delivery and application. For long distances it is possible to transmit large units of energy and distribute the same successfully under the most difficult conditions, and for the most protracted and exacting service. An example of what can be done is found in the electrical transmission plant at Lauffen, Germany. From here power was transmitted 110 miles to the Frankfort Electrical Exposition. The power at Lauffen was derived from a waterfall, and was utilized in creating another waterfall at the Exposition.

At St. Moritz, Switzerland, an extensive power plant is in operation. Here the water is taken to the station through a line of pipe about 26 inches in diameter over a distance of more than 800 yards. The total amount of power available is 1,000 h. p. The water motors at present installed in the station are three turbines of 160 h. p. each, each turbine directly connected to an alternating current dynamo of 80 kilowatts capacity. The main line is about three miles long, and is constructed of bare copper wires supported in oil cup insulators. The current is supplied to five transformer stations having a total capacity of 25 converters, which reduce the pressure from 3,000 to 100 volts. The plant is at present supplying current to 3,000 incandescent and 20 arc lamps.

The Dalmatia mine and mills, situated far up in the California mountains, distant from Placerville, the nearest railway station, about 15 miles, and nearly 60 miles from Sacramento, have a power transmission plant of no little interest. Here, owing to the scarcity of fuel, the adoption of electricity became necessary. The nearest water is Rocky Creek, a stream running down from the mountains into the western fork of the American River. The creek was tapped about two miles above the point where it empties into the river, and the water was then led through ditches dug and blasted along through the rocky soil until a point was reached about 100 feet above the river, and 200 feet away from it. At the junction close down to the river bank was placed a large power station, and the neceesary amount of water led out through an iron pipe 28 inches in diameter running down the hillside. At the power house is installed a large Pelton water-wheel operating a Brush compound wound generator, giving 1,800 volts and 40 ampères. The current from this is led through a circuit of No. 3 copper wire over the mountains to the mills 1½ miles distant from the power house. The complete circuit is, therefore, a little over three miles in length. Here the motor equipment is situated and drives the stamps, settlers and other mining machinery.

A most interesting power tranmission has been made on the Comstock in Nevada. The installation consists of

six 125 h. p. Brush generators, to the shaft of each of which is attached a Pelton wheel. These generators are located in a chamber 25 × 50 feet at the Sutro tunnel level of the Chollar shaft, 1,680 feet below the surface. The water is supplied to these wheels under a head of 1,680 feet. The six generator circuits all lead to a switchboard, and are so arranged that the current from any one of the generators can be put on to any of the outgoing motor circuits. From this point the wires are carried up the shaft to the motor room adjoining the mill, the total length of each circuit being a little over a mile. The six motors with which the wires from the generators are connected are arranged in a single row parallel to the main driving shaft, to which they are belted in the usual manner. A 10-foot Pelton wheel is also connected to this shaft and is supplied with water under a head of 460 feet. Before the electric plant was installed this wheel was the only source of power. The mill contains 60 stamps and the necessary amalgamating machinery. It is claimed that 65 per cent. of the power generated at the wheels is available at the mill.

COAL CUTTING BY MACHINERY.

The principal inducement to operators to use coal cutting machinery in preference to mining by hand labor is the reduction in the cost of getting out the coal secured by the former and more improved method. By machinery it is also possible to effect a larger saving of the coal than by hand labor, because of the small height of the undercut. To get out an equal amount of coal it is not necessary, when using machinery, to keep as many working places open as when employing hand labor. This makes it possible to have the working places more concentrated, and thereby to save a large amount of expense in the form of deadwork, such as keeping open gangways.

To give an approximate idea of the cost of mining machinery as compared with hand labor, it can be stated that a coal cutter in the Hocking Valley is capable of giving an output of 80 to 85 tons a day. The price paid for cutting the coal in rooms is 8 cents per ton; the price paid for loading coal after being cut is 35 cents per ton. A miner can mine and load on an average three tons per day, being paid 75 cents per ton.

This shows a cost of 43 cents per ton of coal mined by machines against 70 cents mined by hand. To the former will have to be added wages for one engineer, fuel, interest and wear and tear of the plant. By working the machines day and night, however, these last items can be reduced to a minimum. This policy is being followed in most mines using machinery, as it enables a comparatively small machine plant to give a large daily output. For example, should an output of 800 tons per day be required, and the machines be worked during the day only, 10 coal cutters, with the necessary engines and apparatus, would be necessary. By working day and night 5 coal cutters would do the same amount of work, while the engines, generators and conductors would be reduced in size one-half.

In room and pillar work the coal is generally undercut the entire width of the room to a depth equal to the height of the vein. It takes about nine or ten cuts to accomplish this in a room 30 feet wide. After the undercut is made, three or four holes are drilled in the coal about two-thirds of the height from the floor, but varying with the condition of the vein. The coal is then shot down, after which it is loaded into the mine cars by a set of miners and the room is cleaned up for another set of cuts. While the work of drilling, blasting and loading is going on, the coal cutter is taken into another room prepared for it, where the process is repeated.

The amount of work a machine is capable of performing in a given time is best expressed by giving the number of cuts it can make, or the number of square feet it can undercut. This daily work of course varies somewhat with the nature of the coal, whether it is hard or soft, or contains impurities in the shape of partings, sulphur, bony coal or slate. The largest record so far made with rotary coal cutters is 52 cuts in 10 hours, or 950 square feet undercut. The average work in the same mine in wide workings is 35 cuts, or 645 square feet; for narrow and wide workings, 30 cuts or 555 square feet. When handled by expert men and with not too hard coal, machines can make about 30 to 35 cuts a day in from 9 to 10 hours, making it necessary to prepare at least four rooms for each to work in.

To convey the machines from room to room, they are mounted on small trucks and hauled by mules or horses from one place to the other. The trucks are generally provided with a suitable winch and chain, by means of which the machines can be readily loaded. The average time to do this is about 2 minutes and 45 seconds.

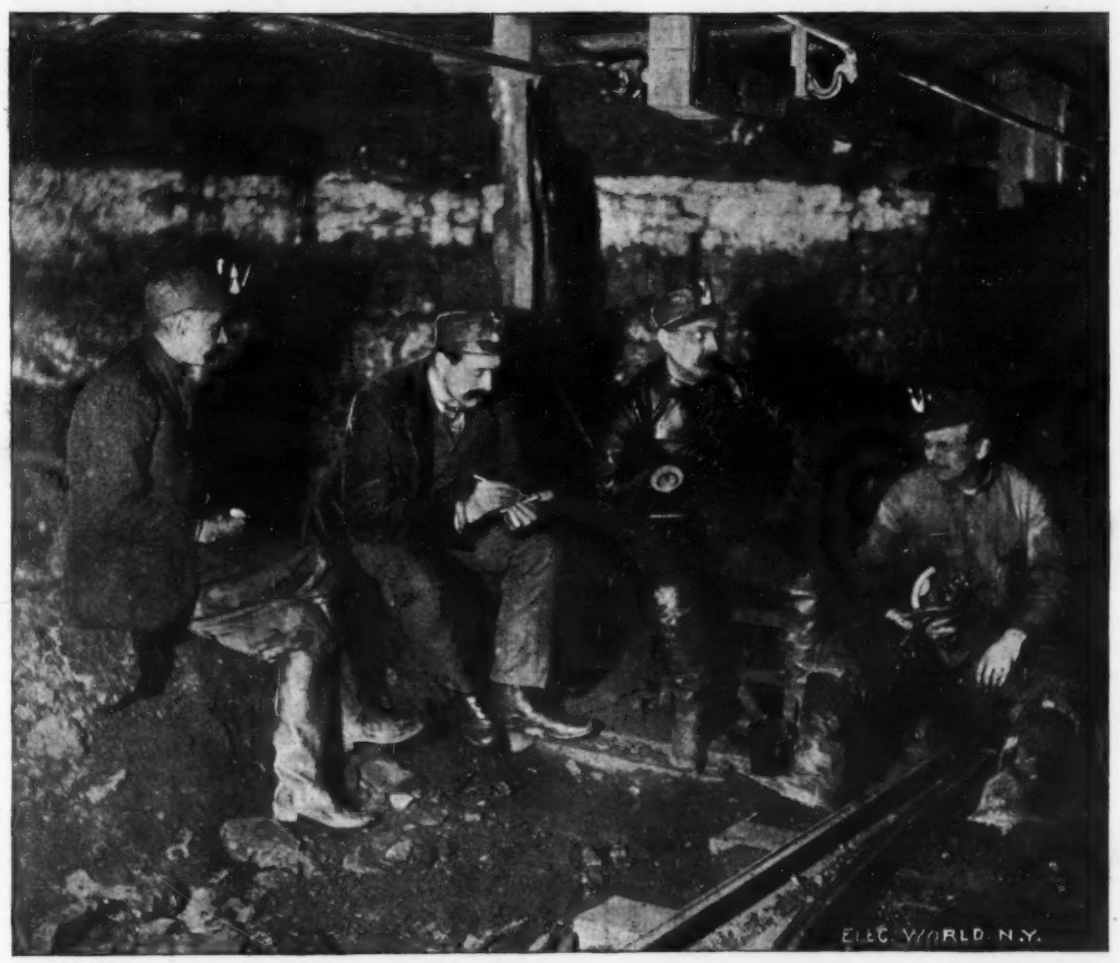
The coal cutters in use in this country can be divided into two main classes, each of which is adapted to certain conditions. To the first of these belong the rotary coal cutters, which make the cut by a rotary or scraping motion. To the second belong the punching machines, which make the cut by means of blows.

The report of the Hon. R. M. Haseltine, State Inspector of Mines of Ohio, given on this page, will be of interest as showing what has been accomplished in one State in electric mining.

## Coal Cutting by Electricity in Ohio.

BY R. M. HASELTINE, CHIEF INSPECTOR OF MINES OF OHIO.

Electricity has continued the displacement of other power as a means of producing coal during the past year, notwithstanding the many discouraging features that its advocates have encountered. Many of the large operators who are anxiously looking for the best and cheapest means of producing coal look upon it still as an experiment and a power whose derivation is too mysterious to be relied upon. This feeling seems to be more generally confined to the operators who have been using compressed air as a power in their mines. At the close of the year 1889 its use was confined to the mining of coal in mine No. 2 of the Morris Coal Company, at Jobs, in Hocking county, and the Whip-Poor-Will mine, of the Shawnee & Ironpoint Company at Shawnee, in Perry county, two Jeffrey machines being used in each. Coal was then being hauled by electric motors at mine No. 3 of the Morris Coal Company, at mine No. 19 of the Sunday Creek Coal Company at Buckingham, and at the Shawnee & Ironpoint mine at Shawnee. At all of these mines hauling was discontinued during 1890, as the power required to operate the motor could be used more advantageously in mining the coal than in hauling it. During the year just closed two machines were added to the plant of the Morris Coal Company at Jobs, making four now in use there. The same company installed an electric plant at its No. 3 mine at Sand Run, in which it is working three machines. Mr. W. H. Upson, at Shawnee, equipped his mine with two machines and a motor haulage. The Morgan Run Coal Company, at Coshocton, equipped its mine with one Jeffrey machine and a motor haulage. The two latter are the only motors in use in the State during the year. Mr. Sutherin installed a plant at his Prospect mine at East Palestine, using three machines. The Crescent Coal Company, formerly the Nelsonville Coal and Coke Company, have a power plant installed by the Sperry Electric Company near Jacksonville, in Athens county. They did some mining while developing the mine, but not of sufficient magnitude to form a factor in the year's production. The Sunday Creek Coal Company abandoned its haulage plant during the year, the Morris Coal Company superseded its plant by extending the tail rope system, and the Shawnee & Ironpoint Coal and Iron Company's mine remained idle a large part of the year owing to some official difficulties, but on renewing operations did not resume the use of the motor during the year. At the close of the year there were eight electrical plants in operation, four of which were installed during the year. Of these the Jeffrey Manufacturing Company built four, the Minott Electrical Company one, and the Sperry Electric Company, of Chicago, one. Of those in operation the preceding year, Brush Fork Nos. 2 and 3, at Jobs, were installed by the Sprague Electric Railway and Motor Company, of New York, and the one at Ironpoint was installed by Bidwell & Kimball, of Chicago, Ill. The year 1889 closed with four Jeffrey mining machines in use in the State, and the year 1890 closed with fifteen of these machines in daily operation. There were several inventors of mining machines ready to enter the field at the beginning of the year, but up to its close the Jeffrey machine was the only one that could be relied upon to return economic results, and is the only one that can be classed as a standard machine. Hence, in reporting the progress made during the year, it is the only machine considered in this investigation. In comparing the power produced at the central stations with the number of machines in operation in the mine, I was induced to make some experiments with a view of determining where the apparent excess of power was consumed, it having been generally claimed and universally admitted that a 15-h. p. motor was abundantly strong to run a machine, while a plant with two generators of 75 h. p. each, running at full speed, could operate but four machines and drive two electric fans. This proportion of loss of power seemed to apply to all the plants in the State. At the close of the year, with the aid of three expert electricians, a tour was made of the electrical mines of the State with a view of scientifically determining where this extra power was being consumed. The circuits were opened at the machines and an ampère and volt meter inserted, and the readings of these were taken every fifteen seconds throughout each cut, the prime object being to determine the power required to undermine the coal, as well as to locate the loss in power in the different mines in which electricity was being used; and again it was desired to determine the fluctuation of the current, as hard and soft places are met in the cutting, and the effect, if any, when the knives are sharp or when they are dull.




State Inspector Haseltine. W. M. Schlesinger. Mr. Card. H. N. Lord.

TESTING ELECTRIC COAL MINING MACHINES IN OHIO.

The first visit was made to the Brush Fork mines of the Morris Coal Company, at Jobs, where machine No. 11 (mine number) was tested while making three cuts as before described, the minimum horse power required being 12.1, the maximum horse power 17, and the average 15.1 h. p. Machine No. 10 was tested during seven cuts, the minimum horse power required was 14.8, the maximum was 23.5 and the average was 19.1 h. p. Machine No. 9 was tested while making six cuts. The minimum horse power required was 17.1, the maximum was 24.5 h. p. and the average 22.1 h. p. Machine No. 12 was tested while it made four cuts. The minimum horse power required was 12.9, the maximum was 16.8 h. p. and the average 15.3 h. p. At the Morris Coal Company's mine No. 1, or Sand Run machine No. 1,024 (the maker's number), was tested while it made two cuts. This machine has been in use four months, and was working 750 feet from the generator. The current was conducted by a No. 0000 wire, to which the machine was connected by 240 feet of No. 4 cable. The minimum horse power required was 13, and the maximum was 16.3, the average being 14.5 h. p. The bits are said to run ten cuts in this mine without changing.

The next test was made at the Upson mine at Shawnee. The power plant consists of a 100-h. p. dynamo, with automatic pressure regulator, and Ideal engine. Machine No. 1,023 was tested while making three cuts. It was located 1,700 feet from the power house, by which it was connected with a double line of No. 0000 wire for 1,200 feet, and a single line of No. 1 wire for the remaining 500 feet. It was connected to this conductor by a cable 50 feet in length. This machine had been in use three months. The bits are changed every eight to twelve cuts, fresh bits being used during the test. The minimum horse power per minute required was 9, the maximum horse power 13.2, and the average was 11.6.

Machine No. 1,025, in the same mine, was tested while one cut was made. The minimum horse power was 9.7, the maximum 11.5, and the average was 10.5. The machine was 1,500 feet from the generator. When running under a pressure of 220 to 235 volts the armature had a speed of 1,230 revolutions. It makes an average of eight cuts with one set of knives.

The next visit was made to Prospect slope, owned by Mr. Geo. D. Sutherin, at East Palestine, in Columbiana county, where a Jeffrey plant had been installed during the summer. The power plant consists of an 80-h. p. Buckeye engine, which drives a 100-h. p. United States generator. The electrical pressure is maintained at 250 volts. The current is carried into the mine by a No. 0000 wire, no insulating coating being used. Machine No. 1,027 is a new type of the Jeffrey machine. It is much lower than the old ones, being 2.2 feet over all. The coal is 3 feet 6 inches, and the bearing-in is made partly in a band lying under the coal and partly in the fire clay floor. This machine was tested while making two cuts. The minimum horse power was 10.1, the maximum was 19.2, and the average was 16.4 h. p.

Machine No. 1,026 (maker's number) was next tested while making three cuts. This machine is of the new type making three cuts, required an average of 10.4 h. p. each cut, and No. 1,030, tested during one cut, required 11.6 h. p. to run back.

Tests were made with a number of these machines to ascertain how much power was required to operate them without cutting coal. Machine No. 9, while running with the feed thrown out, tested for one minute, required 7.5 h. p.; with the feed thrown in and not cutting, the first minute required 7.6 h. p., and during the second minute 8 h. p.; machine No. 12, running one minute without feed, required 6 h. p.; with feed on the same length of time, 6.4 h. p.; machine No. 1,023, without feed for one minute, averaged 5.6 h. p.; with the feed on the same length of time averaged 5.8 h. p.; machine No. 1,025, for one minute without feed, required 4.4 h. p.; with feed, 4.6 h. p.; machine No. 1,027, tested without feed for one minute, required an average of 5.8 h. p.; with the feed on, 6.0 h. p.; machine No. 1,026, without feed, 5.8 h. p.; with the feed on, 5.9 h. p.

The number of tests made being too great to enumerate fully in this article, I have prepared the accompanying table, in which will be seen the average results obtained by comparison of the readings throughout each cut made by the several machines tested. From the trial of six machines I have been able to determine the average horse power to undercut one square foot of coal in one minute, which furnishes a ready means of comparison of the power required to undermine the coal in the mines that have been considered this way.

In installing an electric power plant three essential points are to be considered: first, the total amount of power required at the point where it is to be used; second, the power required to transmit that power from the generator to the point where the mining machines are at work; third, the size of the generator required. It can be readily seen from the table of horse powers here given, what is the total horse power required for any number of the machines considered, when working in veins of coal similar to those where tests were made, which furnishes the foundation for the first step in this computation. Thus, if we were to use five of the Jeffrey mining machines in a vein of coal similar in hardness to that in the Upson mine at Shawnee, where it has been found that each machine requires an average of 11.2 h. p., the five machines would require a total of 56 h. p. To determine the second step the power determined in the first step is first taken into consideration, then the length and diameter of the wire to be used in conducting the current to the mine. As the greater the diameter of the wire the less resistance there is to overcome in the transmission it follows that in any mine the power wasted in transmission can be regulated by simply changing the size of the wire. The amount of this loss should be determined beforehand, but in determining this there enter so many elements that a discussion of them here would occupy too much space. It has been determined by expert electricians that the amount of loss in transmission in good practice lies between 5 and 25 per cent. After having determined what the percentage of loss will be, the following is the formula to determine the size of the wire it will be necessary to use: $D = K\sqrt{HP \times L}$. Here $D$ represents the diameter of the wire in inches and decimals of an inch. $HP$ equals the horse power as found in the first of this article. $L$ represents the length of the wire from the generator to the mining machines, measured along the path of the wire. $K$ represents a quantity which depends upon the per cent. of loss and the voltage used. The values of $K$ for different voltages and percentages of loss may be found in tables of electrical constants especially prepared for this work. For example, it is desired to work five mining machines, requiring 20 h. p. each, at a distance of 4,000 feet from the generator, using a pressure of 220 volts, with a loss of 15 per cent. In this instance $K$ equals 1.373. This problem would be $1.373\sqrt{400 \times 100}$. The result would be the diameter of the wire required, which, in this instance, would be .868 of an inch. The third question for consideration is the generator, which should be of sufficient capacity to deliver an amount of power equal to that required to both operate the machines and overcome that lost in transmission. It is equally important that the generator and conductor should be of sufficient size to run all the machines when they are using the maximum amount of power without danger of injury.

TABLE SHOWING THE RESULTS OF EXPERIMENTS MADE WITH ELECTRICAL MINING MACHINES IN OHIO, 1890. BY R. M. HASELTINE, CHIEF INSPECTOR OF MINES.

| Name of Mine where Test was Made. | Number of cuts made while testing. | Number of machine. | Width of cut. Ft. | Width of cut. In. | Depth of cut. Ft. | Depth of cut. In. | Square feet undercut. | Time in cutting. Min. | Time in cutting. Sec. | Time in making the cut. Min. | Time in making the cut. Sec. | Electric horse power used in cutting. Maximum. | Electric horse power used in cutting. Minimum. | Electric horse power used in cutting. Average. | Average horse power used in running back. | Horse power required to overcome frictional load. With feed off. | With feed on. | To feed. | No. h. p. required in cutting | H. P. required to undercut one sq. ft. of coal in 1 min. | Speed of armature. | Voltage. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Jan. 7, 1891.** | | | | | | | | | | | | | | | | | | | | | | |
| Brush Fork | 1st | No. 11 | 3 | 3 | 5 | 8 | 18.4 | 8 | 45 | 6 | 45 | 17.1 | 15.9 | 16.2 | 7.6 | 5.4 | 6.7 | 1.3 | 9.5 | 10.2 | | |
| No. 2 Hocking Co | 2d | " | 3 | 3 | 5 | 8 | 18.4 | 7 | 30 | 7 | 00 | 16.0 | 12.1 | 15.7 | ..... | 5.4 | 6.7 | 1.3 | 9.0 | 10.1 | | |
| Morris Coal Co | 3d | " | 3 | 3 | 5 | 8 | 18.4 | 7 | 37 | 7 | 00 | 17.0 | 13.7 | 15.6 | 7.9 | 5.4 | 6.7 | 1.3 | 8.9 | 10.0 | | |
| | 1st | No. 10 | 3 | 3 | 5 | 8 | 18.4 | 6 | 54 | 5 | 00 | 18.7 | 16.2 | 17.3 | 9.0 | 5.3 | 5.7 | 0.4 | 11.6 | 8.8 | | |
| | 2d | " | 3 | 3 | 5 | 8 | 18.4 | 6 | 00 | 5 | 30 | 20.6 | 16.2 | 18.4 | 11.1 | 5.3 | 5.7 | 0.4 | 12.7 | 9.5 | | |
| | 3d | " | 3 | 3 | 5 | 8 | 18.4 | 6 | 25 | 5 | 45 | 23.2 | 19.1 | 22.0 | 9.9 | 5.3 | 5.7 | 0.4 | 16.3 | 10.8 | | |
| | 4th | " | 3 | 3 | 5 | 8 | 18.4 | 7 | 30 | 7 | 00 | 23.5 | 18.3 | 21.9 | 10.7 | 5.3 | 5.7 | 0.4 | 16.2 | 11.9 | | |
| | 5th | " | 3 | 3 | 5 | 8 | 18.4 | 7 | 34 | 7 | 15 | 20.0 | 14.8 | 19.7 | 10.2 | 5.3 | 5.7 | 0.4 | 14.0 | 11.2 | | |
| | (1) 6th | " | 3 | 3 | 5 | 8 | 18.4 | 6 | 00 | 5 | 30 | 21.7 | 15.6 | 19.4 | 10.4 | 5.3 | 5.7 | 0.4 | 13.7 | 9.8 | | |
| | 7th | " | 3 | 3 | 5 | 8 | 18.4 | 7 | 28 | 7 | 00 | 20.9 | 15.4 | 18.6 | 8.9 | 5.3 | 5.7 | 0.4 | 12.9 | 9.8 | | |
| **Jan. 8, 1891.** | | | | | | | | | | | | | | | | | | | | | | |
| | 1st | No. 9 | 3 | 3 | 5 | 8 | 18.4 | 4 | 55 | 4 | 30 | 22.8 | 18.2 | 20.8 | 9.0 | 7.5 | 7.6 | 0.1 | 13.2 | 10.9 | 1,420 | 225 |
| | 2d | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 05 | 4 | 30 | 20.7 | 17.1 | 18.8 | 10.8 | 7.5 | 7.6 | 0.1 | 11.2 | 10.4 | | |
| | 3d | " | 3 | 3 | 5 | 8 | 18.4 | 4 | 32 | 4 | 00 | 23.7 | 22.9 | 23.4 | 11.7 | 7.5 | 7.6 | 0.1 | 15.8 | 11.0 | | |
| | 4th | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 38 | 4 | 45 | 24.2 | 23.1 | 23.6 | 10.7 | 7.5 | 7.6 | 0.1 | 16.0 | 11.7 | | |
| | 5th | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 00 | 4 | 30 | 24.0 | 21.9 | 22.9 | 11.6 | 7.5 | 8.0 | 0.5 | 14.9 | 11.7 | | |
| | 6th | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 49 | 5 | 15 | 24.5 | 21.9 | 23.5 | 9.2 | 7.5 | 8.0 | 0.5 | 15.5 | 12.4 | | |
| | 1st | No. 12 | 3 | 3 | 5 | 8 | 18.4 | 8 | 30 | 5 | 45 | 16.8 | 12.8 | 15.3 | 8.4 | 6.0 | 6.4 | 0.4 | 8.9 | 9.2 | 1,233 | 245 |
| | 2d | " | 3 | 3 | 5 | 8 | 18.4 | 6 | 44 | 5 | 15 | 16.7 | 14.7 | 15.7 | 8.4 | 6.0 | 6.4 | 0.4 | 9.3 | 9.1 | | |
| | 3d | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 45 | 5 | 15 | 16.0 | 14.6 | 15.4 | 9.1 | 6.0 | 6.4 | 0.4 | 9.0 | 9.0 | | |
| | 4th | " | 3 | 3 | 5 | 8 | 18.4 | 5 | 33 | 5 | 00 | 16.1 | 12.1 | 15.0 | 8.8 | 6.0 | 6.4 | 0.4 | 8.6 | 8.7 | | |
| Sand Run Mine | 1st | No. 1,024 | 3 | 3 | 5 | 6 | 17.8 | 4 | 25 | 4 | 00 | 16.3 | 11.7 | 13.9 | 6.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Morris Coal Co | 2d | " | 3 | 3 | 5 | 6 | 17.8 | 6 | 15 | 5 | 45 | 15.5 | 14.4 | 14.9 | 6.8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Upson's Mine, Shawnee, O | (2) 1st | No. 1,023 | 3 | 3 | 5 | 7 | 18.1 | 5 | 59 | 5 | 00 | 12.0 | 9.0 | 11.2 | 6.3 | 5.6 | 5.8 | 0.2 | 5.4 | 7.3 | ..... | ..... |
| | 2d | " | 3 | 3 | 5 | 7 | 18.1 | 5 | 40 | 5 | 00 | 12.1 | 9.6 | 11.2 | 6.7 | 5.6 | 5.8 | 0.2 | 5.4 | 7.3 | ..... | ..... |
| | 3d | " | 3 | 3 | 5 | 7 | 18.1 | 5 | 48 | 5 | 15 | 13.2 | 9.6 | 11.2 | 7.1 | 5.6 | 5.8 | 0.2 | 5.4 | 7.4 | ..... | ..... |
| | 1st | No. 1,025 | 3 | 3 | 5 | 7 | 18.1 | 5 | 30 | 5 | 00 | 11.5 | 9.7 | 10.5 | 7.1 | 4.4 | 4.6 | 0.2 | 5.9 | 6.3 | 1,230 | 220 to 235 |
| Prospect Slope, East Palestine, Columbia County. January 24, 1891. | (3) 1st | No. 1,027 | 3 | 3 | 4 | 2 | 13.5 | 5 | 30 | 5 | 00 | 16.8 | 10.1 | 15.0 | 7.7 | 5.8 | 6.0 | 0.2 | 9.0 | 9.3 | ..... | ..... |
| | 2d | " | 3 | 3 | 4 | 2 | 13.5 | 5 | 53 | 5 | 30 | 19.2 | 14.3 | 17.6 | 8.3 | 5.8 | 6.0 | 0.2 | 11.6 | 10.8 | ..... | ..... |
| | (4) 1st | No. 1,026 | 3 | 3 | 4 | 6 | 14.6 | 6 | 37 | 6 | 00 | 27.0 | 17.1 | 22.3 | 8.9 | 5.8 | 5.9 | 0.1 | 16.4 | 12.9 | ..... | ..... |
| | 2d | " | 3 | 3 | 4 | 6 | 14.6 | 6 | 45 | 6 | 15 | 28.9 | 17.5 | 25.3 | 12.0 | 5.8 | 5.9 | 0.1 | 19.4 | 14.2 | ..... | ..... |
| | 3d | " | 3 | 3 | 4 | 6 | 14.6 | 6 | 30 | 6 | 00 | 26.5 | 16.6 | 22.7 | 10.4 | 5.8 | 5.9 | 0.1 | 16.8 | 12.9 | ..... | ..... |
| | (5) 1st | No. 1,030 | 3 | 3 | 4 | 6 | 14.6 | 6 | 53 | 5 | 30 | 29.6 | 18.5 | 24.5 | 11.6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Shawnee and Iron Point | (6) 1st | ..... | 3 | 3 | 5 | 6 | 17.8 | 4 | 00 | 3 | 30 | 24.9 | 11.8 | 20.2 | ..... | 6.2 | 7.4 | 1.2 | 12.8 | 9.9 | 1,455 | ..... |
| | (7) 2d | ..... | 3 | 3 | 5 | 6 | 17.8 | 4 | 47 | 4 | 00 | 23.5 | 15.0 | 19.9 | ..... | 6.2 | 7.4 | 1.2 | 12.5 | 10.2 | ..... | ..... |
| Leichner machine at Shawmut, Elk County, Pa. | 1st | ..... | 3 | 0 | 4 | 3 | 12.7 | 4 | 30 | 2 | 30 | 17.8 | 15.2 | 16.4 | 10.1 | 4.96 | 4.98 | 0.02 | 11.4 | 7.3 | ..... | ..... |
| | 2d | ..... | 3 | 0 | 4 | 2 | 12.6 | 4 | 30 | 2 | 33 | 18.0 | 14.2 | 16.3 | 9.7 | 4.96 | 4.98 | 0.02 | 11.3 | 7.2 | ..... | ..... |
| | 3d | ..... | 3 | 0 | 4 | 2 | 12.5 | 4 | 14 | 2 | 45 | 18.7 | 14.6 | 16.2 | 9.8 | 4.96 | 4.98 | 0.02 | 11.2 | 7.4 | ..... | ..... |
| | 4th | ..... | 3 | 0 | 4 | 7½ | 13.9 | 4 | 10 | 2 | 42 | 19.3 | 13.4 | 16.8 | 10.7 | 4.96 | 4.98 | 0.02 | 11.8 | 7.3 | ..... | ..... |
| Thomson-Van Depoele at Shawmut, Elk County, Pa. | 1st | ..... | 3 | 0 | 3 | 7¾ | 10.9 | 4 | 21 | 2 | 45 | 11.5 | 5.6 | 9.0 | 5.0 | 2.70 | 3.06 | 0.36 | 6.0 | 7.0 | ..... | ..... |
| | 2d | ..... | 3 | 0 | 3 | 4¼ | 10.0 | 3 | 55 | 2 | 10 | 9.3 | 7.5 | 8.3 | 4.0 | 2.70 | 3.06 | 0.36 | 5.3 | 4.2 | ..... | ..... |
| | 3d | ..... | 3 | 0 | 3 | 2½ | 9.6 | 5 | 20 | 3 | 00 | 15.4 | 8.6 | 12.2 | 6.0 | 2.70 | 3.06 | 0.36 | 9.2 | 6.0 | ..... | ..... |

(1) The sixth cut with machine No. 10 was made with new knives. (2) The first cut with machine No. 1,023 was made with new knives. (3) The first cut with machine No. 1,027 was made with new knives. (4) The knives in machine No. 1,026 had made one cut before the test was made. (5) The knives in machine No. 1,030 had made three cuts when the test was made. (6) At the Shawnee and Iron Point mine the first cut was made in the fireclay which forms the floor. (7) At the Shawnee and Iron Point mine the second cut was made in the coal.

## Conventional Electricity.

There are many curious ideas which linger in the academic mind, says our English contemporary *Industries*, and will, it is to be feared, never be eradicated. For instance, probably nine-tenths of the writers of text books appear to think that electrical engineers use sine and tangent galvanometers for measuring, let us say, dynamo currents. Another established idea is that dynamos have something called a "critical speed," and that dynamo makers turn out

dynamos by the hundred without knowing what a critical speed may be. Of course we do not pretend to know either. Again, makers have worked for years to design voltmeters and ampèremeters to give proportional readings. It is needless to remark that voltmeters should have their scales spread out near the standard pressures, while ampèremeters should have similar scales for some purposes, and logarithmic scales for others. No instrument has yet been designed to give a logarithmic scale. The back electromotive force of the arc is now an old established and eminently reputable phenomenon. Yet an electro-chemical pressure of thirty odd (very odd) volts is extreme, and there is no evidence to show that the conductivity of the arc does not vary as the cross section, and approximately as the current.

## The Discussion on the Report of Committee on Units and Standards of the American Institute of Electrical Engineers.*

Mr. HERING: Regarding this report I think the work is very creditably done and that we can be very glad that our committee is doing such good work. I think, however, that there might just as well have been added a fifth unit which expresses magnetic conductivity or permeability, in order to complete the series. It would be the reciprocal of the fourth. It has been left out entirely in the report. Perhaps there is some reason for having left it out.

Mr. C. O. MAILLOUX: I indorse the remarks of Mr. Hering, as to the creditable manner in which this work has been done by the committee. I would take exception only with regard to some of the practical units, so called, that is to say, the practical values. That is a question which interests greatly those who have to deal with the use of these practical values. There is room for discussion as to what values are the most expedient to give the practical units. The committee has seen fit to use as the unit of magnetomotive force, $\frac{1}{4\pi}$ × ampère of one turn, which is, I think, a convenient practical value. Now, we can assign any values to the other two units if we assign them in the proper reciprocal relation, and still be able to use the formula analogous to ohms. In other words, we would be able to write: The flux equals the magnetomotive force divided by the reluctance, and we could have that relation maintained for almost any sets of values of the magnetic flux and reluctance. The committee has given the practical unit of flux the value of $10^8$ C. G. S. lines, which involves, of course, giving to the reluctance the reciprocal value of $10^{-9}$; and the magnetic intensity has been made $10^8$, the same as the magnetic flux. Now, the practical unit of one hundred million C. G. S. lines per square centimetre appears to me rather high, inasmuch as the values we deal with practically are seldom over 10,000 or 15,000; and as it is admitted that 25,000 to 30,000 are natural values I do not see the logic of using a value so entirely out of reach and calling it a practical unit. It is true that we could use the term "micro"; at the same time it seems to me we might just as well shorten the nomenclature by using a practical value more within industrial bounds. The practical unit of flux, $10^8$, would seem to be taken from its relation to the other units, such as the volt. I think we could sacrifice to some extent the convenience of a strictly uniform system in order to obtain convenience in other respects. I have to manipulate these several quantities a great deal in connection with the design of electrical machinery, and I have been in the habit for some two years past of using a unit of flux which is one million C. G. S. lines, or $10^6$, which I find to be very convenient because it is a quantity which you meet with very constantly in practice and its use does not involve too many decimals or too large a figure. At the same time, as we want to have something which fits all the requirements and which applies as nearly as possible to all cases, I would be in favor of further reducing the values of the practical unit of flux to $10^4$, or 10,000 C. G. S. lines, and of taking the corresponding value of $10^5$ for magnetic reluctance, which still preserves the mathematical relations of the formula analogous to ohms, while at the same time it gives us values within ordinary limits. Then in dealing with flux we could use the terms "deca" and "hecta," while the unit of magnetic intensity would be about right, 10,000 lines per square centimetre, a value constantly met in practice and which one could handle without needing any prefix, such as "milli" or "deca," or any other term. It seems to me that this is a matter which wants to be very carefully considered. We are going to assign values to these units not for one day, but forever, so far as we know, and we want to be cautious and consider well that we do it in a manner that will be of the greatest convenience to the greatest number.

Prof. FRANCIS B. CROCKER: That point has already been discussed in this room very thoroughly in connection with the unit of inductance. If Mr. Mailloux's suggestion could be carried out we should all be very thankful, but it is probably impossible. We now have the farad as a unit, however awkward it may be, and we must use the microfarad for ordinary practical work. The farad must be related to the coulomb and the volt directly in the ratio of 1 to 1, for if it had a relation of a millionth to 1 it would introduce a still worse objection to the system of units. In that respect the units are perfect. Hence, when we come to the magnetic units we must simply follow this rule. The farad is more awkward than any of these new units, and yet we have had it for a long time and it would be undesirable to change it. In fact, I think any one who carefully considers this matter will say it is out of the question to change the farad, and the same thing is true of these proposed magnetic units. The members of the committee are unanimous on that point. I have seen no one yet who has given this question careful attention, who has not become completely convinced on that score. I would call attention to the fact that the word "practical," as applied to these units, should be put in quotation marks. The farad is called the "practical" unit of capacity, because it is directly related to other units, the values of which were selected on account of their supposed practical convenience. We can select values for the first few units in a system, and the rest follow as a natural and inevitable consequence and any one who attempts to change them will get into still worse trouble. So that word "practical" should not be taken in any literal sense. It merely means a unit which is related to the volt or other fundamental units in the simple ratio. We should have a third column in our table of units, as I pointed out some time ago—*working units.** Thus we have the absolute units, the so-called practical units and the real working units. The volt and the ohm were chosen to be both practical and working. But in the case of the farad this is not the case. In the case of the henry the "practical" value is very nearly a "working" value. In the case of the proposed magnetic units the two values are unfortunately quite different, but we cannot help ourselves.

Mr. TOWNSEND WOOLCOTT: I agree with Prof. Crocker in regard to this system business. It seems to me there are only two ways to make a practical system of units, either the way it has been done—to fix on the most important values and let the others come in as they will, or else go on the other tack and make all the practical units about the convenient size and let the discrepancy come in the equations. That is, introduce factors into all the equations to make them come right. It is always assumed that the factor has the power of 10. I think that most electricians would seriously object to the introduction of a constant into the equation $C = \frac{E}{R}$, because that is an equation which is used so much. We either have got to have the units of an inconvenient size or else introduce multipliers into some of the equations. I presume from what Prof. Crocker said that the units given by the committee here are all supposed to be the systematic practical units. But the unit of electrical density is $10^8$ C. G. S. lines per square centimeter. The unit of length in the practical system is $10^0$ centimetres, and the unit of area is consequently $10^{18}$ square centimetres, which makes the practical unit of density $10^{-10}$ C. G. S. units instead of $10^8$. If you consider that this belongs to the practical system you have got to consider that there are two units of length. We will call one the subjective unit of length or the imaginary one, and the other the objective unit of length, by which we measure the magnetic circuits. Of course the centimeter is a very convenient length for measuring dynamo machines; it is just about right. But the square centimeter is not the systematic unit of area according to the practical system of units.

Prof. W. A. ANTHONY: I just want to say one word in regard to this discussion that has been brought out on the value assigned to these practical units, and that is this: that in assigning the value of 1 to 1 we are following out the plan that has been adopted in assigning the values to other practical units that have already been adopted. If we do anything else than this we shall have a relation that we shall have to memorize. Now if we make our practical unit one which is a ratio of 1 to 1, and then apply a prefix that may be necessary in order to give a working unit, that prefix indicates the relation. We know that our practical unit has a ratio of 1 to 1. If we adopt $10^4$ which gives the ratio 2 to 1 we have got to remember that it is 2 to 1, and by and by somebody will be making mistakes through not remembering whether it is 1 to 1 or 2 to 1 or 4 to 1. And then there is nothing in the name of the unit to indicate what its relation to the other unit is. Let us stick, I say, to the relation that has already been adopted, making the unit 1 to 1, and then adopting such a prefix as will indicate the relation of the working units to the practical units. I think there is another reason for this—that the electricians of the old world, I do not believe, will ever consent to any other arrangement, and this society of electrical engineers, although it is a society of a good deal of importance, cannot upset what has already been adopted by the electricians of the old world.

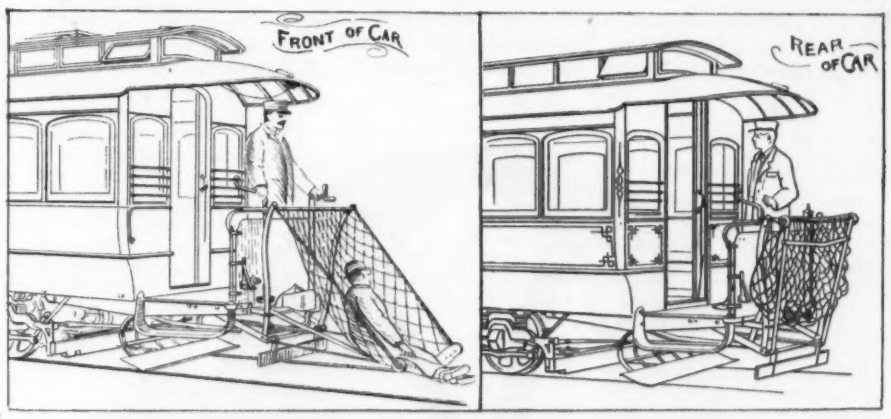
Mr. KENNELLY: I would like to explain the action of the committee in reference to an important point that has been raised as to the relation between the second and third units. The third unit is the flux referred to the unit of cross section. It is a question—shall be it flux density per square centimetre or flux density per square earth's quadrant? There is in the case of this unit the difference, that whereas all the other units are in the relation 1 to 1 and come into connection with each other continually, in formulæ and in practice, the magnetic intensity which is referred to the square section of circuit is a subsidiary unit only. It is not a part of the main line. It is a side track. We can afford to depart there from the strict measure of the earth's quadrant without that danger of creating confusion which would certainly result if we were to adopt the centimetre in place of the earth's quadrant in the regular succession of "practical" units. One or the other has to be adopted. It is a matter for discussion. But the opinion of the committee was that it should be flux density per square centimeter. That would seem to be much more convenient. It seemed to give a unit which was not hopelessly too small, and although not according to the strict "practical" linear unit, the earth's quadrant, it was not a unit that would be likely to introduce confusion. It is true that the system of proposed units here exhibits a weak point. But it is also true that it is a moot point, and it probably can never be finally decided except by an international congress. It may be that the institute will prefer to attach to that particular clause a statement marking that a departure has here been made from the strict earth's quadrant unit of length, but it is a matter which is difficult to decide at present, and it fortunately appears in a unit of lesser importance.

*For the full text of this report see THE ELECTRICAL WORLD, Sept. 26, 1891.

* Address before New York Electric Club, December, 1890.

## Safety Fender for Electric Cars.

The Chester Manufacturing Company, of Boston, gave a very successful test on Wednesday last of the Appleyard safety fender for electric cars before a large number of interested people, including Chairman Crocker, of the Massachusetts Board of Railroad Commissioners; Prof. Swain, bridge engineer; a number of railroad men and others, all of whom were highly pleased with the exhibition of the new fender. Chairman Crocker expressed the opinion that it was most the successful test of any similar safety device he had yet seen. The fender, as shown in the accompanying illustration, consists of a triangular steel frame projecting from the front of the car on each side, the two frames being connected by steel rods at the bottom. Over this frame is stretched a stout rope netting. The front and bottom of the fender is raised nine inches from the track, sufficiently high to catch and throw into the net any person standing on the track, no matter at what speed the car might be running. In case the person was lying flat on the tract, or in case of a small child that could by any means pass under the fender, a projecting arm would be struck releasing a scoop which drops down to the track in front of the wheels. This, it is said, would pick the obstacle up whatever it might be.




FENDER FOR ELECTRIC CARS.

A dummy of straw and sand was used in making these tests. The trial was made on the tracks of the Newton (Mass.) street railway and Superintendent F. G. L. Henderson, of the railway company, ran the car. The dummy was encountered at various car speeds and when in various positions. In each case it was thrown into the netting, and those present were thoroughly satisfied of the efficiency of the protector as a safeguard for life and property. The officers of this company are A. P. McPherson, president; A. E. Appleyard, secretary, and its offices are at 53 State street, Boston.

## The First Thomson-Houston Tramway in England.

The inauguration of the Roundhay Electric Tramway in Leeds, Oct. 29, was an event of considerable importance in the history of electric traction in the United Kingdom. As will be remembered, the Board of Trade, by virtue of the electric lighting acts and their amendments, prohibits the erection of overhead wires; but in special cases this regulation is relaxed, provided the consent of the local authority is first given. The obtaining of the permission of the latter to the putting up of aerial wires is rather a difficult matter, inasmuch as English and other municipalities have been prejudiced against overhead wires.

Until last week the only two tramways operated from

aerial conductors on the European continent were in Bremen and Halle, Germany, the Thomson-Houston system being used in the former town. Now, however, England boasts of an overhead line, the Roundhay Electric Tramway, which was opened as stated. Mr. W. S. Graff Baker is the lessee and Mr. J. E. Winslow is the manager. The line extends from the junction of Roundhay and Chapletown roads to the new entrance of Roundhay Park. It was leased to Mr. Graff Baker on the 15th May last for a period terminating Oct. 31, 1892, and for the purpose of installing the Thomson-Houston system, which had been accepted by the Highways and Tramways Committee of Leeds Town Council.

The car depot contains four tracks, with accommodation for 12 cars. A pit, 30 feet by 40 feet, allows of inspection or cleaning of four cars simultaneously.

### A Combined Fan and Motor.

The accompanying illustration shows a new combined motor and ventilating fan intended for exhibition at the London Electrical Exhibition, which opens Jan. 1, 1892. The apparatus is manufactured by the Huyett & Smith Manufacturing Company, of Detroit, Mich., and will be made in sizes varying from 21 to 48 inches in diameter of fan, having a capacity of from 8,000 to 40,000 cubic feet of air per minute and using from one to three horse power. The motors used are wound for 220-volt circuits.

### Lieb's Improved Bracket Line Hanger.

The accompanying illustration shows Lieb's new bracket or centre pole line hanger with new universal clip. This clip is now made in two sizes, one to take wires from No. 0 to No. 2 and the other from No. 2 to No. 4 inclusive.

Although the Lieb standard universal clip will hold any wire from No. 0 to No. 4, it is preferred, on account of the great difference in these extreme sizes, to furnish two sizes as above, which makes a more satisfactory job when put up.

The insulator is exactly the same as in the Lieb standard trolley line hanger and was fully described in The Electrical World of Aug. 8, 1891. The upper clamp, as now made, will fit on a 1½ inch gas pipe, and when 1¼-inch pipe is used a sheet of fibre or rubber can be placed between the pipe and the hanger clamp, thus obtaining double insulation where iron poles are used.

### The Hoggson Automatic Time Stamp.

This little machine, the works of which occupy the small space of less than two and a half by three inches, and three inches high, prints the year, month, day, hour and minute clearly and distinctly in a space that can be covered by a silver quarter. By the aid of electricity the machine automatically changes the minutes and hours, and at 12 o'clock, midnight, it changes the day. On the first of the month the machine is set, when it will run day and night without any attention whatever till the first of the next month, when by a simple movement, as easy as the setting of a watch, it is ready for another trip of a month's duration.

This machine is the invention of Mr. Samuel H. Hoggson, and will be placed upon the market by the Stevenson-Hoggson Electric Company, of 919 Olive street, St. Louis, Mo., of which Mr. W. H. Stevenson is president. It is operated by a g ntle pressure instead of a blow, and prints from endless rubber type bands of peculiar construction, which will, it is claimed, always give a clear impression, though used on uneven surfaces, such as an envelope with an enclosure.

In addition to the date and time the machine will print any lettering that can be got in a space the size of the die holder, which is 2 by 2½ inches, and, as these are interchangeable, any number of dies may be used, as they can be changed instantly. On the face of the machine are dials, which will denote month, day, hour and minute, a glance at which will show the position of the printing characters, thereby avoiding any possible mistake, and at the same time transforming the machine from a simple stamp to a clock and perpetual calendar.

The machine can be operated on open or closed circuit by a battery or by continuous or alternating electric light current, and is adapted to run on any signal or time circuit where the impulse is given once a minute.

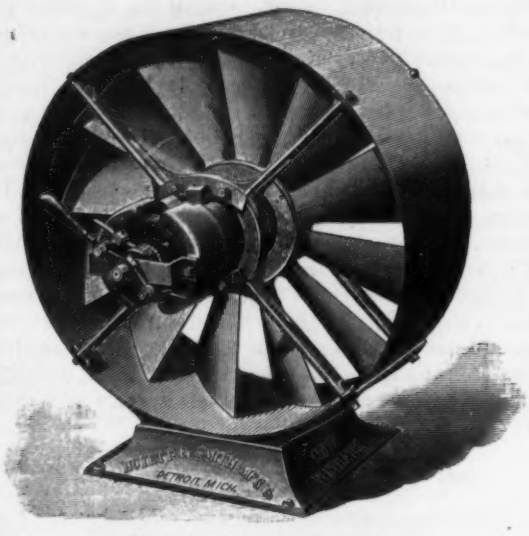
### A New Corliss Engine.

On this page is shown a new design of Corliss engine built by the Sioux City Engine Works, of Sioux City, Iowa. This company has the largest engineering plant west of the Mississippi River devoted exclusively to the manufacture of high grade engines and complete steam plants, with a capacity of turning out 150 engines annually. The company has recently built and equipped new shops at Leeds, Ia. (Sioux City's manufacturing suburb), with a view of making a specialty of the manufacture of this line of goods. The old shop, tools, fixtures, etc., have been sold off and all lines of business dropped except the manufacture of high grade engines.

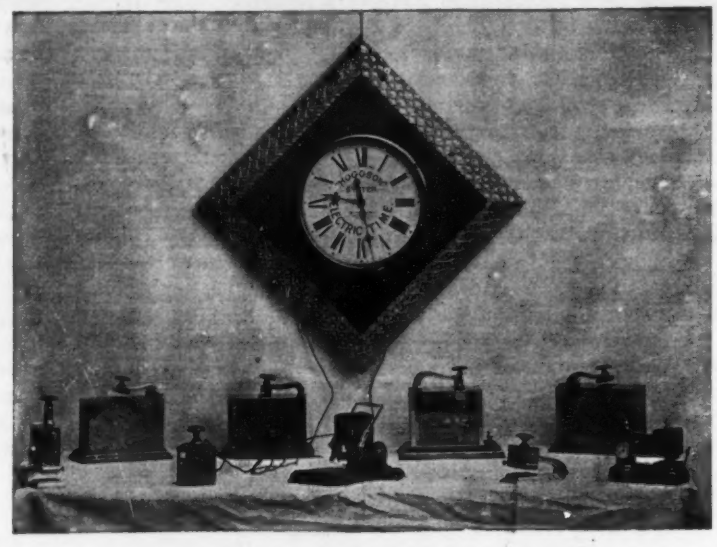
The illustration shows the company's new design of Corliss engine bed, which has been remodeled and redesigned with special reference to weight and stiffness in order to adapt it to the heavy and fluctuating loads of electric lighting and railway service. The engine is built in sizes from 50 to 500 h. p., and the company's slide valve automatic engines from 30 to 150 h. p.

It will be noticed that in the design of the bed extra material has been placed in it near the pillow block, to insure stiffness to resist strains due to overhang. The main bearing pedestals and cylinder feet are from three to four times as heavy and broad as those of the old patterns, giving a far better bearing on the foundation and a greater degree of stability and rigidity. In the outer pillow block, vertical adjustment is provided for, the convenience of which will be readily appreciated by all practical engineers. The guides for the beds are all bored on independent centres. All the machine work on the bed is completed at one setting.

In the design of the cylinder, an independent exhaust passage has been provided beneath, with dead air space between it and the cylinder proper. The steam is taken between the valves, not over them, and the most improved hook-motion valve gear is used. Many of these engines are working in electric lighting stations, the speed varying less than 2 per cent. from extreme heavy to light loads. This is guaranteed in every instance where the engines are used for electric lighting.

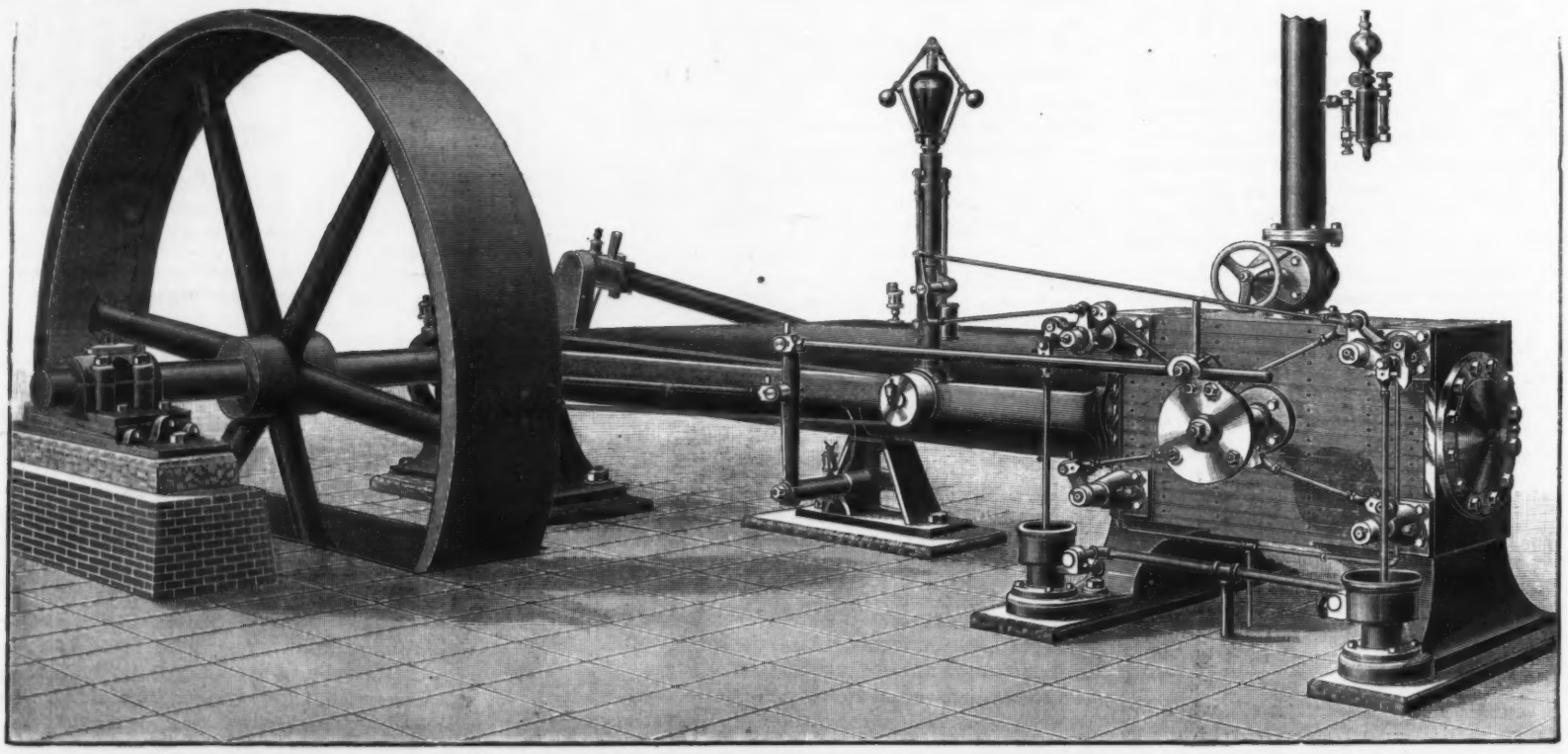


COMBINED FAN AND MOTOR.



AUTOMATIC ELECTRIC TIME STAMP.

BRACKET TROLLEY WIRE HANGER.



CORLISS ENGINE OF THE SIOUX CITY ENGINE WORKS.

# Financial Intelligence.

## THE ELECTRICAL STOCK MARKET.

**The Closing Quotations** of electric stocks on Saturday, Nov. 14, 1891, in New York and Boston were:

| Name of Stock. | Par. | Capitalization. | Bid. | Ask'd. |
|---|---|---|---|---|
| Western Union Telegraph Co | 100 | 86,200,000 | 82½ | 82⅞ |
| American Telegraph & Cable | 100 | 14,000,000 | .... | 80 |
| Central and South American | 100 | 5,000,000 | .... | .... |
| Mexican | 100 | 2,000,000 | .... | .... |
| Commercial Cable Co | 100 | 7,716,000 | .... | .... |
| Postal Telegraph Cable | 100 | 5,000,000 | 28 | 33 |
| Edison General Electric | 100 | 15,000,000 | 94 | 95 |
| Consolidated Electric Light | 100 | 2,500,000 | 20 | 30 |
| Edison Illuminating Co., New York | 100 | 4,500,000 | 80 | 81 |
| " " " Brooklyn | 100 | 750,000 | 75 | 78 |
| " " " Boston | 100 | 1,263,500 | 97½ | 102½ |
| " " " Chicago | 100 | 750,000 | 135 | 145 |
| U. S. Illuminating Co | 100 | 1,250,000 | 30 | 35 |
| North American Phonograph Co. | ... | ..... | 2 | 4 |
| New York Phonograph Co | 100 | 6,200,000 | 2½ | 4 |
| Edison Elec. Light Co. (of Europe) stock. | 100 | 2,000,000 | 2½ | 5 |
| " " " " bonds | ... | 30,000 | 65 | 75 |
| " Ore Milling Co | 100 | 2,000,000 | 17½ | 22½ |
| " Toy Phonograph Mfg. Co | 10 | 1,000,000 | ½ | 1 |
| U. S. Electric Light Co | 100 | 1,500,000 | .... | 20 |
| Brush Illuminating Co., of New York | 50 | 1,000,000 | 40 | 50 |
| Mt. Morris Electric Light Co | ... | 500,000 | .... | 60 |
| East River Electric Light Co | 100 | 1,000,000 | .... | 60 |
| Thomson-Houston Electric Co | 25 | 6,000,000 | 46½ | 47½ |
| " " preferred | 25 | 4,000,000 | 25 | 26 |
| " International Electric Co | 100 | 1,000,000 | .... | 200 |
| Thomson Electric Welding Co | 100 | 1,000,000 | .... | .... |
| " European Electric Welding Co | 100 | 1,500,000 | 20 | 25 |
| Westinghouse Electric Co., assented | 50 | 7,000,000 | 12¼ | 13 |
| Fort Wayne Electric Co | 25 | 4,000,000 | 12½ | 13 |

**Chicago Quotations.**—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

| | | | |
|---|---|---|---|
| Chicago | $212@ $220 | Cumberland | $60@ $62 |
| Central Union | 51@ 52 | Wisconsin | 118@ 120 |
| Michigan | 81@ 83 | Bell of Missouri | 175@ 180 |
| Great Southern | 30@ 32 | Iowa Union | 20@ 22 |
| Colorado | 34@ 36 | Missouri and Kansas | 54@ 56 |
| Rocky Mountain Bell. | 40@ 43 | | |

ELECTRIC LIGHT STOCKS.

| | | | |
|---|---|---|---|
| Chicago Arc Light and Power | $97@ $99 | Chicago Edison Co | $139@$145 |

## NEW INCORPORATIONS.

**The Ypsilanti Electric Company,** of Ypsilanti, Mich., with a capital stock of $25,000, has been incorporated to supply electric light and power to Ypsilanti. Brainard Rorison, M. V. Rorison, both of Fort Wayne, Ind., and A. C. Rorison, of Ypsilanti, are the promoters.

**The Washburn Electric Light and Power Company,** of Washburn, Wis., with a capital stock of $20,000, has been organized to prosecute the business of electric lighting and electric power supply. A. C. Prohert, J. F. Meehan and Peter Nelson are the incorporators.

**The B. & S. Storage Company,** of Sioux City, Ia., with a capital stock of $1,000,000, has been organized to manufacture, buy, sell, etc., storage batteries, dynamos and electrical appliances. The incorporators are E. M. Dunbar, C. S. Wallis and J. Y. Bradbury, all of Sioux City.

**The Bronx Electric Light Company,** of New York, N. Y, and Westchester, N. Y., with a capital stock of $15,000, has been formed to manufacture and use electricity for light, heat and power John B. Munn, J. S. Bush and Charles C. Leary, all of New York City, are the organizers.

**The Ronceverte Electric Company,** of Ronceverte, W. Va., with a capital stock of $100,000, has been formed for the purpose of supplying light, heat and power to the town of Ronceverte. Thos. J. Shyock, Geo. F. M. Houck and Jas. E. Brower, all of Baltimore, Md., are the incorporators.

**The Phœnix Electric Company,** of Duluth, Minn., has been organized with a capital stock of $10,000, to manufacture and deal in supplies for the production, utilization and application of heat, light and power. J. M. Anderson, Robert S. Eyster and H. R. Fish, Jr., all of Duluth, are the incorporators.

**The Eldredge Electric Company,** of Bloomfield, N. J., with a capital stock of $100,000, has been organized to manufacture and sell and otherwise exploit electrical and other inventions of Rolfe Eldredge. Chas. L. Heins, Bloomfield, N. J.; R. Eldredge, New York, and M. C. Kellogg, of Mt. Vernon, N. Y., are the incorporators.

**The Morgan Electric Light and Power Company,** of Morgantown, W. Va., with a capital stock of $100,000, has been formed to establish an electric plant at Morgantown to supply light and power to the consumers. H. S. Sands, O. S. McKinney, of Fairmount, and G. C. Sturgiss, of Morgantown, W. Va., are the incorporators.

**The Astoria Street Railroad Company** has filed articles of association with the Secretary of State at Albany, N. Y., to operate a railroad from the foot of Fulton street, Astoria, at the East River, to the town of Newtown, at Grand avenue, a distance of about two miles. The capital stock is $100,000, divided into 1,000 shares. The directors are Edward M. Tyrrell and James H. Christian, of Brooklyn; Michael E. Conway, James W. Lamb, James E. Nixon, James E. McWilliams, of Long Island City; Anthony Miller, of New York, and John J. Delaney, of College Point.

## AFFAIRS OF THE COMPANIES.

**The Edison Sault Light and Power Company,** of Sault Ste. Marie, Mich., it is stated, has made a general assignment for the benefit of its creditors.

**The St. Louis Electrical Supply Company,** of St. Louis, Mo., held a meeting of the board of directors recently, Mr. E. Reubel and Mr. A. H. Reese being present. E. F. Horn was elected director in place of W. L. Scott, deceased. Mr. Ernest Reubel was elected president and treasurer and H. T. Platt secretary.

**Thomson-Houston.**—It was believed at the beginning of the year, says the Boston *News Bureau*, that the Thomson-Houston Electric Company would earn this present fiscal year from $2,000,000 to $2,500,000 net, or not far from $1,000,000 above all dividend requirements. Of course it was not expected that the phenomenal earnings of $3,000,000 net made last year were to be repeated this year, but it now looks as if $2,500,000 net might be reached the present fiscal year ending Feb. 1, 1892, or more than $1,000,000 surplus over the $1,240,000 required for dividends upon the present basis. There is therefore good reason for the expectation by Thomson-Houston stockholders of something more than $4 per share from present earnings. Below is a comparative statement of the business of the Thomson-Houston company for the three months ending Oct. 31, 1891 and 1890, and for the nine months ending same dates in 1891 and 1890. The profits shown, however, are for the Boston office only.

| Quarter ending Oct. 31: | 1891. | 1890. | Inc. | Dec. |
|---|---|---|---|---|
| Gross sales | $3,098,573 | $2,785,073 | $313,500 | ..... |
| All exp. and commissions. | 2,273,408 | 2,078,886 | 194,522 | ..... |
| Net profit | $825,165 | $706,187 | $118,978 | ..... |
| Nine months ending Oct. 31: | | | | |
| Gross sales | 7,163,411 | 7,514,520 | ..... | $349.109 |
| All exp. and commissions. | 5,600,628 | 5,888,431 | ..... | 287,803 |
| Net profit | $1,562,783 | $1,626,089 | ..... | $63,306 |

# Special Correspondence.

## NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Nov. 23, 1891.

**Mr. George F. Porter,** of Philadelphia, has been appointed secretary of the National Electric Light Association, to take the place of Mr. Beane, who has resigned his position.

**S. Dana Greene,** general manager of the sales department of the Edison General Electric Company, left for the South on an important business trip on Tuesday of last week. He is expected to return in a few days.

**I. H. Silverman,** familiarly known as "Old Silver," the popular Pittsburgh agent of the Edison General Electric Company, was in town last week. When spoken to regarding business he simply replied, "We are hustling as usual."

**Deputy Sheriff Murphy** last week sold out the property of the United States Volta Electric Company, of No. 38 Wall street, including 38,972 shares of United States Volta Electric Battery Company stock, 25,000 shares Ohio Volta Electric Battery Company, 6,665 shares Volta Electric Light and Power Company, 10,000 shares Eclipse Electric Company, of West Virginia, safe, office furniture, etc., the proceeds of the sale amounting to only $327.

**Mr. W. M. Miner,** of Plainfield, N. J., called at our office last week and gave a very interesting exhibition of his electric soldering iron. The iron which he used was wound for 110 volts and uses about 1½ ampères. Starting cold, the iron reaches a fine heat in about two minutes, and retains its temperature so that the work of soldering is not interrupted and the finest work may be accomplished. Mr. Miner has been engaged recently in the telegraph service of the Northwest, but has now returned, and expects to devote his time to pushing the soldering iron. L. H. H.

## NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 21, 1891.

**The Redding Electric Company** has secured the New England Agency for the Aluminium Carbon Company, of Buffalo, N. Y., whose carbons are well known for their superior quality.

**The Deane Steam Pump Company,** of Holyoke (Mass.), has been obliged to materially increase its facilities by the erection of a large new shop. Business is reported as good in all departments.

**B. F. Perkins & Son,** of Holyoke, Mass., are meeting with good success with their ventilating fans and are about to bring out a direct connected motor and fan embodying some new features and many improvements over the old style.

**The Germania Electric Company.**—Mr. O. K. Stuart has resigned as treasurer and has formed a copartnership with Mr. B. B. Stoddard, formerly with the Woonsocket Electric Machine and Power Company, and will represent the Germania Company in its Southeastern department, with offices at Philadelphia.

**The Consolidated Electric Manufacturing Company** now occupies the store corner of Franklin and Congress streets, which will be used as show and sales room, where they will carry a full line of gas and electric fixtures and be in shape to display the various specialties manufactured by them. This company has just issued a new catalogue which is something out of the usual line of such publications. C. A. B.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 21, 1891.

**Mr. George F. Porter,** secretary of the National Electric Light Association, was in Chicago last week.

**Mr. J. R. Burdick,** of the H. W. Johns Manufacturing Company, New York, called on various Chicago houses this week and talked Vulcabeston very successfully.

**Mr. F. H. Leonard,** president of the Electrical Engineering and Supply Company, Syracuse, N. Y., left a very pleasant impression with all on whom he called during his Western trip and is now receiving many orders for the specialties which he controls.

**Will Not Pay for "Puffs."**—It is stated that the committee of press and printing of the World's Fair has decided that no consideration will be paid to the publishers of newspapers for any news or advertising matter concerning the Exposition which they may publish.

**The Committee on Grounds and Buildings,** of the World's Fair, has concurred in a recommendation of the Committee on Electricity that the subways for conveying electric light wires throughout the grounds be constructed of wood, concrete and plaster. There will be in all several miles of the conduits and subways, which will cost between $30,000 and $50,000.

**Mr. Charles D. Jenney,** of the Jenney Electric Motor Company, of Indianapolis, Ind., was a welcome visitor in Chicago this week. Mr. Jenney says that his company transacted more business last month than in the three preceding months, and that the orders already received this month far exceed the total business of last month, while the prospect for an increasing trade during the winter is very encouraging.

**A Marked Decrease in Traffic.**—The quarterly report of a horse car line for the quarter ending June 30, 1890, showed that 284,838 passengers were carried during the three months. Three blocks distant a horse car line running on a parallel street introduced rapid transit, and though less convenient to reach must have secured the majority of the passenger traffic of that section, as the quarterly report of Sept. 30, 1891, of the first named road, showed that but 86,356 passengers were carried during that quarter.

**The Madison Car Works,** of Madison, Ill., has its handsome shops in full operation and is working night and day on orders for railway cars. All the machinery is driven from lines of shafting aggregating over 3,000 feet, supported on or from nearly 700 boxes and hangers, while the clutch couplings and pulleys are of large diameter. All the work was planned, built and installed by the Hill Clutch Works, of Cleveland, O., while the belting was principally supplied by the Charles Munson Belting Company, of Chicago.

**The Emerson Electric Manufacturing Company,** of St. Louis, Mo., is nicely settled in its new quarters, 1,108 & 1,110 St. Charles street, where it has an abundance of daylight and ample room for its steadily increasing business, which has grown so rapidly as to necessitate an increase in the capital of $25,000, making a stock total of $75,000. The company is incorporated under the Missouri laws. Its stock room is unusually well arranged and to prevent any delay a large amount of everything required is kept constantly on hand.

**In order to harmonize the relations** existing between the Committee on Grounds and Buildings of the World's Fair and the Committee on Electricity the Executive Committee has adopted the following rule: "All plans for construction involving the application of electricity and pneumatics for the production of light or power or heat shall be first submitted to the Committee on Electricity for its consideration and approval. When so approved and certified by said committee said plans shall go to the Committee on Grounds and Buildings."

**A Social Entertainment.**—On Monday evening, Nov. 23, there will be a social entertainment at the rooms of the Chicago Electric Club. The following programme will be presented: 1. Humorous paper, C. C. Haskins. 2. Song, Quartette. 3. Recitation, Mr. Fielder. 4. Trial by jury of Prof. Badt, for stealing four watts from Terry's field. For the prosecution, Judge Buckley; for the defense, Judge Degenhardt. 5. Song, Quartette. 6. Recitation, Mr. Fielder. 7. Punch. 8. Lunch. This is the first of a series of entertainments which will be presented through the winter season, if a sufficient number of members attend.

**The Electric Appliance Company** is getting its large store at 242 Madison street in shape for business. The shelves are rapidly filling with goods and the company hopes to be able to take care of its trade in its new store with the best of facilities for doing business. A force of carpenters and painters are at work upon the offices and store front and everything gives promise that in a very short time the Electric Appliance Company will have perfect facilities for every department of its business. It is the intention to keep a moderate stock of everything carried on the main floor so that all orders can be filled with the least possible delay, a point which will be appreciated by the city trade and will also shorten the time required for freight shipments. The company reports the closing of arrangements for the exclusive Western agency for several very valuable specialties. The large experience of all the members of the firm in the electrical supply business will enable them to place their orders more rapidly and to the best advantage.

**The St. Louis & Suburban Railway Company,** of St. Louis, has its new power house practically completed and its car barns well under way. One Hamilton-Corliss engine of 1,200 h. p. is now in position, and the various parts of the second are on the ground. Rohan horizontal boilers and Pond separators are used, and the steam pipes are protected with Magnesia sectional covering. Ten Thomson-Houston generators are in position, and will be belted to a line of shafting and clutch pulleys, erected by the Hill Clutch Works, of Cleveland, O. The shaft is nine inches in diameter, the stands are solidly built and supplied with self-oiling ball and socket bearings, requiring attention but once in three months, and from the time the plant was started, some six weeks ago, not a moment has been lost, though the shafting is in constant operation from 4 A. M. till after midnight. This road was originally equipped with a cable system, being the old Cable & Western Railway, and was compelled to adopt some other form of rapid transit or lose its traffic. Indications now point toward it proving the most profitable road in the city.

**Plans have been completed** for lighting nine of the buildings of the World's Columbian Exposition, and the lighting facilities contemplate the installation for those buildings of 5,180 arc lamps of 2,000-c. p. each, and 14,700 incandescent lamps of 16-c. p. each. Arc lights will be used in most of the buildings, but the Fine Arts, Administration and Woman's buildings are to be furnished with the incandescent electric light. Each building will, however, be furnished with wires for incandescent lighting in order to accommodate the exhibitors. In case any one wishes to fit up his exhibit with ornamental lights he will have the facilities at hand for doing so. The Fine Arts building will be a blaze of incandescent lamps, and it is estimated that one mile of wall space, on which pictures may be hung, will have to be lighted. The number of lamps agreed upon is 12,000. There are to be no arc lights in this building. It is expected that the lighting effects will completely overshadow the Paris Exposition and will be available day and night, so that the exhibits can be seen to good effect in the night time, which will be a great improvement over the Centennial Exposition, where no opportunity whatever was afforded for night exhibit.

**The Chicago Amateur Electrical Society** met at its permanent quarters, room 5, 120 Quincy street, recently, and decided to change its name to "The Chicago Society of Operative Electricians." The objects of this society are the advancement of its members in the knowledge of electrical science by lectures to be given by prominent electricians interested in the society, and by a thorough course of study, using standard works under the supervision of an instructor. Mr. H. G. Brownell, a college graduate of several years' practical experience, has been chosen for this position. As soon as the finances of the society will permit a library will be started, in connection with which a laboratory will be fitted up in order that theory may be demonstrated by practical experiment, a manner of study which has been adopted by our best colleges and manual training schools. Another feature of the society will be an amateur electrical display at the World's Fair. Mr. J. Allen Hornsby, secretary of the electrical department of the Columbian Exposition, in an address to the society, stated that the department would endeavor to secure for it the same honors given the professionals in all departments which could possibly come in its sphere. He also promised that heat, light and power would be furnished for the exhibit. A committee has been appointed to make arrangements for an exhibition. It is earnestly requested that all young men interested in the study of electricity will take an interest in the work of the society, and that similar societies and experimental clubs will correspond and co-operate with this society in its endeavor to secure a creditable amateur electrical display at the World's Fair. All communications should be addressed to the corresponding secretary, S. G. Arnold, room 5, 120 Quincy street, Chicago. F. DE L.

KANSAS CITY, Mo., Nov. 19, 1891.

**A. Irwin,** superintendent of outside construction for the National Electric Company, has been here.

**Thos. Wolfe** has put in a 1,000-light alternating machine at the Swift Packing Company, and a 65-light alternator at Corles' Oatmeal Works.

**The Franklin Electric Company** has secured the general agency for Texas, Kansas and Western Missouri for the Eco magneto clock.

**The Western Storage Battery Company** has secured a building in West Kansas, and will begin the manufacture of storage batteries inside of 60 days.

**A suit** between the Electrical Secret Service Company and the Gill-Alexander Electric Company for the possession of a patent automatic electric lock has dragged through seven days, before Judge Henry of the Circuit Court. The first named company is com-

posed of E. L. Martin, A. W. Jones and Thos. H. Clohesy, and claims to have purchased the patent of Edward Gill. A short time ago the Gill-Alexander folks were enjoined from the manufacture of the locks pending the decision in the courts. Judge Henry has rendered a decision in favor of the plaintiff. It will be carried to the Court of Appeals. H. D. E.

## SOUTHERN NOTES.

NORFOLK, Va., Nov. 21, 1891.

**Bryson City, N. C.**—An electric light plant will shortly be erected.

**Shendun, Va.**—C. H. Rose will put an electric light plant into his saw mill.

**Chattanooga, Tenn.**—The system of the electric light company will be extended in order to supply electric lights to private dwellings.

**Dallas, Tex.**—The capital stock of the Dallas electric light plant has been increased to $400,000.

**Chattanooga, Tenn.**—An electrical process has been added to the plant of the Cahill Iron Company by which plating in brass and bronze may be done.

**San Angelo, Tex.**—The San Angelo Electric Light, Power and Irrigation Company has been organized. An electric light plant will be erected, and a water power developed of 250 h. p., from the Concho River. E. Duggan is president.

**Columbia, S. C.**—The plant of the Congaree Gas and Electric Light Company will be enlarged and the capacity increased and bonds for $100,000 issued for said improvements. It is stated, also, that this company will consolidate with the Columbia Electric Street and Suburban Railway Company.

**Replaced by Americans.**—The superintendent of immigration has been informed that four Canadian telegraph operators employed by the Northern Pacific Railroad Company in North Dakota have been replaced by American operators. It was charged that the employment of the Canadians was in violation of the alien contract labor law.

**The American Graphophone Company.**—An adjourned meeting of the stockholders of the American Graphophone Company was held a few nights ago, to hear the reports of a committee, to ascertain and investigate the condition of the machine and suggest a plan for future action. The committee made a concise and intelligent report, which was enthusiastically adopted by the meeting, and the future prospects of the company were shown to be in somewhat more flattering condition than had been generally supposed. Altogether the meeting expressed itself as satisfied with the condition of affairs, and the board of directors were fully indorsed in their management. V. N. B.

# News of the Week.

## THE TELEPHONE.

**The Bell Telephone Co.** is putting up a line from Fort Smith, Ark., to Waldron.

**Erie Telephone Sub-Companies** made a net gain of 83 subscribers in October. The total number connected Nov. 1 was 13,816.

**Bell Telephone stock** made a great rise from 198 to 213 last week, which was due to the issuing of the Berliner patent from the patent office at Washington. This patent has been in litigation, chiefly through interferences, for some 11 years. These interference suits have been disposed of one by one, until the patent now issues for the usual period of 17 years.

**The Central & South American Telegraph Company** has purchased the Transandine Telegraph Company, having a mileage of 1,200, and connecting Valparaiso with Buenos Ayres. The purchase price is about $587,000, and to raise this the capital stock of the Central & South American company is increased from $6,000,000 to $6,500,000, the balance of purchase price to be paid from the surplus of the company.

## THE ELECTRIC LIGHT.

**Montgomery City, Mo.**—The Montgomery Box Company has started up its plant, furnishing 30 street lights. A National machine is used.

**Victoria, Tex.**—The Victoria Electric Light Company is making arrangements to increase the capacity of its plant by the addition of another dynamo.

**Jonesboro, Ark.**—A contract has been closed for an electric light plant, and a 750-light National machine has been ordered; 40 street lights will be furnished.

**Columbia, Ind.**—The City Council has granted to Henry C. Bailing a ten years' franchise for an incandescent electric light plant. It is expected that the plant will be in operation within 30 days.

**Silver Springs, N. Y.**—C. E. Fargo & Co., of Warsaw, N. Y., have secured the contract for the construction work for lighting the Duncan addition with incandescent lights, to be running by Dec. 1.

**Hastings, Minn.**—The Hastings Electric Light and Power Company's plant has been sold to W. E. Bonwell and W. B. Rentfrow, of St. Paul, the latter acting as manager of the new company.

**Munroe City, Mo.**—W. E. Bailey, southern agent of the National Electric Manufacturing Company, at Louisiana, Mo., has recently closed a contract for a 500-light National machine at this place.

**Charleston, Mo.**—The Electric Light Company will shortly commence operating its new system. A 500-light National machine has been put in, which will be operated by a Westinghouse compound engine.

**Peru, Ind.**—The City Clerk is advertising for bids, which will be received until Dec. 8, for the purpose of furnishing and maintaining 50 or more arc lights for electric lighting. The contract to take effect on the first day of June, 1892.

**Baltimore, Md.**—It is stated that a representative of the Edison company is trying to interest local capitalists with a view to the formation of a company to erect an electric light plant for incandescent lighting, and to supply motive power.

**Cynwyd, Pa.**—The Bala and Merion Electric Light Company, whose officers are Cyrus Chambers, Jr., president; John S. Gerhart, secretary; Jos. R. Rhodes, treasurer; Wm. Hoopes, superintendent, is erecting an electric light plant. The work is to be finished about the middle of December.

**Vergennes, Vt.**—The Vergennes Electric Light Company is composed of Frank E. Briggs, E. S. Marsh, of Brandon, and F. A. Goss and Charles E. Parker, of Vergennes. Contract has been let for the plant and it is expected that it will be in running order by Jan. 1. There will be one arc light dynamo and an alternating machine.

**Paragould, Ark.**—A company has been organized, with a capital stock of $10,000, for the purpose of erecting an electric light plant. Thos. H. Wyse, president; C. Wall, vice-president. A 750-light National machine has been purchased, and 40 arc lamps of 32 c. p. will be furnished to light the town. The city has given $1,000 as a bonus to the enterprise.

**New Brighton, Pa.**—The Home Electrical Company has recently been organized by L. R. Strowbridge, C. C. Robinson, N. N. Davidson, Jos. Mitchell, J. H. Williams, W. A. Coventry and others, for the purpose of furnishing electricity for heating, lighting and power purposes. The company has been awarded a contract for lighting the borough of New Brighton, and expects to furnish light to several other towns.

## THE ELECTRIC RAILWAY.

**A 40-mile electric line** is contemplated to run between Seattle, Washington and Tacoma.

**Olean, N. Y.**—The Olean Street Railway Company has contracted for changing its equipment to an electrical system.

**Chattanooga, Tenn.**—It is reported that the motive power for passenger trains on the Chattanooga Union Railway will be changed to electricity.

**Salt Lake City, Utah.**—An ordinance is pending to grant a franchise to the Salt Lake City Railroad Company to build an electric line on West Temple street.

**Harman, Colo.**—W. H. Spangler and several other citizens are enthusiastic in their efforts to secure funds for building an electric railway line from Denver to Harman.

**San Francisco, Cal.**—The North Beach & Mission Street Railway Company is to be equipped with the overhead trolley system. The line to be in operation April 1, 1892.

**Portsmouth, Va.**—Application will be made to the approaching legislature in Virginia for a charter to build an electrical railroad from Port Norfolk through Portsmouth.

**Baltimore, Md.**—Contract is to be let for the construction of the South Baltimore and Curtis Bay Railroad Company's electrical line, which will be 3½ miles in length, with a two-mile branch.

**Kansas City, Mo.**—The Interstate Consolidated Rapid Transit Railway Company contemplates substituting electricity for cable power on its line between its depot on St. Louis avenue and Delaware street.

**Seattle, Wash.**—A West street car line, of Seattle, Wash., has a freight car equipped with 20-h. p. motors, having a capacity of 15 tons. The West Street line is the pioneer in the use of electricity for hauling freight.

**Application has been made** to the City Council by the Union Passenger Railway Company for permission to operate its line by some system of electricity that shall be approved by the mayor and commissioners.

**Port Townsend, Wash.**—A new electric road is to be built and equipped with electricity. The line will be about six miles long. The owners of the road are J. A. Kuhn, H. Landes, R. C. Hill, T. Jackman and H. L. Burkett.

**Worthington, O.**—Citizens of this place are working for the extension of an electrical line, which will run from North Columbus to Clintonville. A committee has been appointed to secure the right of way and to determine the cost of construction.

**Lowell, Mass.**—The Lowell and Suburban Street Railway Company made a contract on Nov. 15 with Messrs. C. & G. Cooper of Mt. Vernon, O., for three 500-h. p. cross compound Corliss engines, to be used in the new power house of this road, now being erected.

**East Liverpool, O.**—The East Liverpool & Wellsville Railway, a road to be eight miles long, connecting Ohio City, Wellsville & East Liverpool, is to be equipped electrically. The contract has already been awarded to the Short Electric Railway Company, of Cleveland.

**Charlotte, N. Y.**—The report of the earnings of the Grand View Beach Electric Railway gives the following statement of earnings and expenses for the year: Earnings, $17,976.08; operating expenses, $8,500.60; surplus, $9,475.48; interest and taxes, $4,010.34; net surplus, $5,465.14.

**Ottumwa, Ia.**—The electric light, steam heat and street railway interests of this city have all been consolidated and a new company, the Ottumwa Electric Railway Company, has been formed, with a capital stock of $500,000. Chicago capitalists are interested in the new company.

**A New Railroad.**—A company has been organized to construct an electric line from Fonda, N. Y., to Gloversville. Right of way has been secured by Charles M. Gibson, of Schenectady, N. Y., one of the interested parties, and it is stated that an electric road fourteen miles long will be built, to cost $18,000 per mile.

**Fresno, Cal.**—A project is being worked up to construct an electric power plant to operate present and future street car lines. President Pollasky, of the Mountain Railroad, one of the parties interested, stated recently that the new project is a certainty. It contemplates about twelve miles of electric railroads with branch feeders.

**The Atlanta Traction Company,** of Atlanta, Ga., recently issued five per cent. sinking fund 25-year gold bonds to the amount of $150,000. These bonds have been bought by Fisher & Shaw, of Baltimore, and the fact of the purchase is referred to as an exhibit of the increased interest being shown by investors in Southern street railway matters.

**A concession** granting exclusive control of electric rapid transit for the period of 99 years in the city of Monterey, Mex., has been granted to Carlos D. Welsh and Henry Oliver, of Monterey, and G. R. Furr, Burt McDonald and Frank Brown, Jr., of Austin, Tex. The company to be formed under this concession will be exempt from taxation for the period of 20 years. Monterey has a population of 70,000 and has already several millions of American capital invested in cotton factories, smelters and other productive industries.

**As to Electric Roads.**—Some figures which have recently been published showing the large difference between the expense of operating a horse road and an electric road should be carefully studied by the municipal authorities all over the country, says the *Record and Guide*. It seems from the figures (there is no reason to doubt their accuracy) that the cost of power is six times as much to a horse car company as it is to an electric company, and that electric traction can haul the same number of passengers as animal power can at half the delay and twice the speed. When such an increase of efficiency is obtained at such a reduction of cost it is no wonder that horse car companies all over the country are eager to introduce an electric system.

**Electric Street Railways Popular.**—A recent issue of the San Francisco *Report* had the following in regard to electric railway interests: "Electric street and suburban railroads are being rapidly built all over the United States. Wherever they exist they are strongly popular, and the people who have them in use would no more think of exchanging them for cable roads than San Franciscans would exchange their cables for horses. Naturally, as San Francisco was the first to introduce the cable and has a very handsome system of cable roads in which a large amount of capital is invested, the introduction of the electric road proceeds here with difficulty. The difficulty is increased by the strong provincialism of this city, born of isolation from other great cities and general ignorance of their progress. But it will not be long before the superior utility of electric roads will be recognized even here, and then their construction will be very rapid."

**The Williamsport Passenger Railway Company,** of Williamsport, Pa., commenced in May last to change its motive power from animal to electric power. The road had 5½ miles of centre bearing rail; nine cars in operation. Four miles have been replaced and two miles of new double track laid with 60-pound Wharton girder rail. The equipment consists of ten 16-foot cars with McGuire trucks and Westinghouse single reduction motors, the power being furnished by the same company's make of generators. The overhead construction was carefully done, regardless of cost, to remove any municipal objection that might be made. Four cars were put in operation August 6 and four additional cars on Nov. 15. The road will be extended 1½ miles further to a suburb this winter and some three or four miles additional track laid early in the spring.

The officers of the company are as follows; H. R. Rhoads, president; John Lawshe, treasurer; J. F. Starr, secretary; H. C. Young superintendent. Directors: H. C. Parsons, C. L. Munson,, Jno. R. T. Ryan, Wm. Emery, H. W. White.

**Street Railway Reports.**—The following reports of electric street railway lines in Massachusetts have been sent to the State Commissioners. The statistics cover the year ended Sept. 30, 1891:

NEWTON STREET RAILWAY.

| | | | |
|---|---|---|---|
| Capital stock authorized by charter | $50,000 | Repairs of cars and electrical equipment | $5,190 |
| Capital stock authorized by vote | 100,000 | Salaries of officers and clerks | 2,469 |
| Capital stock paid in | 100,000 | Wages of other employés | 14,807 |
| Funded debt | 100,000 | Provender | 608 |
| Unfunded debt | 30,176 | Taxes | 387 |
| Total debt | 130,176 | Rents overhead line | 595 |
| Cash assets | 1,633 | Rent electric motive power | 7,642 |
| Net debt | 128,543 | Insurance | 545 |
| Cost of construction | 152,174 | Total expense of operating | 37,905 |
| Total cost of equipment | 63,082 | Net income above operating expenses | 12,034 |
| Total property and assets | 237,734 | Interest accrued | 6,955 |
| Cost of extensions of tracks | 29,603 | Total surplus or deficit Sept. 30 | 7,559 |
| Cost of new cars | 27,952 | Miles of railway (single track) operated | 5.48 |
| Total addition to property | 56,952 | Total miles run during year | 186,543 |
| Net addition to property | 47,245 | Passengers carried | 1,008,806 |
| Total income from all sources | 49,939 | Round trips made | 17,051 |
| Repairs of roadbed and track | 1,858 | | |

QUINCY & BOSTON STREET RAILWAY.

| | | | |
|---|---|---|---|
| Capital stock authorized by charter | $50,000 | Total expense of operating | $31,048 |
| Unfunded debt | 31,412 | Net income above operating expenses | 820 |
| Cash assets | 8,050 | Interest accrued | 1,015 |
| Net debt | 23,362 | Deficit for the year | 195 |
| Cost of construction | 38,973 | Total surplus Sept. 30 | 6,209 |
| Total cost of equipment | 32,852 | Miles of railway (single track) operated | 7.56 |
| Real estate | 7,745 | Total miles run during year | 115,806 |
| Total property and assets | 87,621 | Passengers carried | 647,202 |
| Net addition to property | 3,755 | Round trips made | 25,392 |
| Passenger earnings | 31333 | | |
| Total income from all sources | 33,868 | | |

BOSTON & REVERE ELECTRIC STREET RAILWAY.

| | | | |
|---|---|---|---|
| Capital stock authorized by charter | $50,000 | Net income above operating expenses | $1,909 |
| Funded debt | 25,000 | Interest accrued | 1,582 |
| Unfunded debt | 14,282 | Surplus or deficit for the year | 326 |
| Cash assets | 5,172 | Total surplus or deficit Sept. 30 | 1,246 |
| Net debt | 34,110 | Miles of railway (single track) operated | 3.80 |
| Cost of construction | 70,534 | Total miles run during year | 16,950 |
| Total cost of equipment | 9,920 | Passengers carried | 133,940 |
| Real estate | 4,902 | Round trips made | 4,557 |
| Total property and assets | 90,528 | | |
| Net addition to property | 305 | | |
| Passenger earnings | 6,697 | | |
| Total expense of operating | 4,788 | | |

HOLYOKE STREET RAILWAY.

| | | | |
|---|---|---|---|
| Capital stock authorized by charter | $150,000 | Total expense of operating | $34,072 |
| Total debt | 33,445 | Net income above operating expenses | 6,965 |
| Cash assets | 25,229 | Interest accrued | 549 |
| Net debt | 8,216 | Dividends declared | 3,000 |
| Cost of construction | 88,203 | Surplus for the year | 3,415 |
| Total cost of equipment | 56,466 | Total surplus Sept. 30 | 14,330 |
| Real estate | 27,877 | Miles of railway (single track) operated | 5.70 |
| Total property and assets | 197,775 | Total miles run during year | 132,600 |
| Net addition to property | 90,431 | Passengers carried | 843,244 |
| Passenger earnings | 40,765 | Round trips made | 29,230 |
| Total income from all sources | 41,037 | | |

WORCESTER CONSOLIDATED STREET RAILWAY.

| | | | |
|---|---|---|---|
| Capital stock authorized by charter | $350,000 | Total expense of operating | $223,139 |
| Funded debt | 150,000 | Net income above operating expenses | 50,797 |
| Unfunded debt | 253,002 | Interest accrued | 17,197 |
| Total debt | 403,002 | Dividends declared | 28,000 |
| Cash assets | 31,828 | Surplus for the year | 5,600 |
| Net debt | 371,174 | Total surplus Sept. 30 | 18,809 |
| Cost of construction | 418,195 | Miles of railway (single track) operated | 21.11 |
| Total cost of equipment | 146,295 | Total miles run during year | 908,639 |
| Total property and assets | 776,312 | Passengers carried | 6,071,948 |
| Net addition to property | 106,410 | Round trips made | 170,237 |
| Passenger earnings | 271,061 | | |
| Total income from all sources | 273,936 | | |

LYNN & BOSTON STREET RAILWAY.

| | 1891. | 1890. |
|---|---|---|
| Capital stock authorized by charter | $1,000,000 | $500,000 |
| Capital stock authorized by vote | 700,000 | 500,000 |
| Capital stock paid in | 660,000 | 500,000 |
| Funded debt | 425,000 | 425,000 |
| Unfunded debt | 93,773 | 103,164 |
| Total debt | 518,773 | 528,164 |
| Cash assets | 49,102 | 37,577 |
| Net debt | 469,671 | 490,587 |
| Cost of construction | 603,543 | 568,263 |
| Total cost of equipment | 358,270 | 328,942 |
| Real estate | 197,086 | 176,474 |
| Total property and assets | 1,208,001 | 1,111,262 |
| Cost of extensions of tracks | 35,275 | 17,031 |
| Cost of new cars | 4,800 | 6,400 |
| Cost of other new equipment | 30,483 | 54,549 |
| Cost of new real estate | 20,612 | 234 |
| Total addition to property | 91,170 | 83,815 |
| Total income from all sources | 593,822 | 583,482 |
| Repairs of road bed and track | 27,395 | 46,323 |
| Taxes | 11,064 | 9,597 |
| Rent paid other roads | 25,800 | 25,029 |
| Insurance | 4,442 | 4,234 |
| Total expenses of operating | 521,812 | 505,906 |
| Net income above operating expenses | 72,010 | 77,486 |
| Interest accrued | 25,879 | 26,835 |
| Dividends declared | 40,000 | 32,000 |
| Surplus for the year | 6,131 | 18,651 |
| Total surplus Sept. 30 | 89,228 | 83,098 |
| Box cars | 118 | 112 |
| Open cars | 133 | 130 |
| Box cars, electric motors | 8 | 7 |
| Open cars, electric motors | 10 | 6 |
| Electric snow plows | 4 | 1 |
| Miles of railway (single track) operated | 62.24 | 60.31 |
| Total miles run during the year | 1,929,523 | 1,841,285 |
| Passengers carried | 11,575,368 | 11,292,330 |
| Round trips made | 237,193 | 227,007 |

## LEGAL NOTES.

**The Brush Electric Company,** of Cleveland, O., has filed a bill in the United States Circuit Court to enjoin the Western Electric Company, of Chicago, from manufacturing and selling an arc electric light, the patent for which complainant says it owns.

**St. Catharines, Ont.**—At the Chancery Court in Toronto, James Bicknell recently applied for judgment against the St. Catharines, Merritton & Thorold electric railway, and for a receiver and managers. The action against the company is taken by bondholders who are interested to the extent of $35,000. Mr. Bicknell appeared more directly on behalf of E. G. Barrow, who holds $1,000 of the bonds. The order was made with a direction to the local master at Hamilton to appoint a receiver. The road has not been paying during the past six months, though it is said there will be a surplus after it is sold over all liabilities. It is eight miles long, connecting St. Catharines and Thorold, and was built in 1876-1877 as a horse railway at a cost of $160,000.

## PERSONALS.

**Mr. J. Slocum,** formerly representing the Hawkeye Electric Manufacturing Company, has gone into the electrical business for himself in Burlington, Ia.

**Mr. Jas. H. Barry,** of South Framingham, Mass., has been appointed manager of the telephone exchange at Burlington, Vt., succeeding Mr. W. J. Burden, who has resigned.

**Mr. J. C. Lincoln,** who superintended the establishment of the electrical plant of the Rochester (N. Y.) Street Railway, has gone to Lincoln, Neb., where he will visit for a few days before returning to his home in Cleveland, O.

## MISCELLANEOUS NOTES.

**The Inventive Age,** published by Messrs. Jas. T. and R. G. Du Bois, Washington, D. C., is three years old, and shows enterprise and prosperity by erecting and occupying a handsome four story building on the corner of Eighth and H streets, Washington. The *Inventive Age* building will be devoted entirely to the business connected with that journal. The motive power used in the printing department is electricity, and the new building is complete in all its appointments.

**A National Code of Electric Rules.**—It is understood that the national electric insurance committee of fire underwriters has formulated a national code of rules for wiring buildings for either electric light or power. The rules cover the proper and safe method of running wires over buildings and through streets and do not relate alone to interior installation; they also deal with electric railways. The rules are regarded as simple and comprehensive, covering the ground thoroughly, and it is expected that they will be generally adopted, inasmuch as insurance and electrical interests are now more inclined to work together harmoniously.

**Modern Magnetism.**—The exhaustive series of articles on "Magnetism in Iron and Other Metals," which has for nearly two years been appearing in the *Electrician*, will shortly be published in book form. The electrical engineer owes a debt of gratitude to Prof. Ewing, not only for his ten years of self-imposed scientific research, but for the fact that he has given his results and the most important ones of his fellow-workers to the public in a coherent and accessible form. The work of a large number of other English investigators has been entombed in the costly proceedings or transactions of the Royal Society, whence, in most cases, it is frequently only unearthed when long forgotten by most people, for the purpose of depreciating the credit due to subsequent workers, who have painfully arrived at correct conclusions in ignorance of and completely unaided by the labors of their predecessors. There is certainly a happy mean between rushing into print with crude results wrapped up in a cloud of meaningless verbiage and imparting valuable results, in a scientific whisper, to a select scientific circle. It is needless to enumerate the services which Prof. Ewing has rendered to the science of magnetism. For years he has been twisting, compressing, laminating, elongating, baking, freezing and otherwise torturing pieces of iron of all qualities, until he seems to have developed a magnetic eye which enabled him to see the actual contortions of the molecular magnets under the painful stresses which he applied to them; the result being his contribution to the molecular theory of magnetism, which, by reason of its "sweet reasonableness" and complete accord with almost all observed magnetic phenomena, immediately met with universal and unqualified acceptation. The publication of Prof. Ewing's book will, it is to be hoped, put a final seal upon the ancient theories, modes of expression and symbols with which the science of magnetism was encrusted but a few years ago in all the text books.

## Industrial and Trade Notes.

**The iron roof** for the storehouse which the United States government is building at Willets Point, L. I., will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

**Wm. H. Weston & Co.,** consulting and manufacturing electricians, of Philadelphia, Pa,, report that their business is improving every day, and that they have a large number of orders ahead with new ones being received constantly.

**Information for Power Users.**—The Jenney Electric Motor Company, of Indianapolis, Ind., has issued some neat tables that will prove useful in the every day use of motors in showing how to ascertain the power required for elevators.

**Zincs for Batteries.**—The Illinois Zinc Company, of Peru, Ill., is filling some large orders for battery zincs of various sizes. As the company is one of the largest in the country, it is able to quickly handle orders of any size, and to furnish zinc sheet plain or cut to order.

**Cylinder Oil.**—An oil that has won a splendid reputation for economical efficiency in the engine room, and especially for giving satisfaction where wet steam is employed, is the Peerless cylinder oil manufactured by George P. Jones & Company, 708 North Main street, St. Louis, Mo.

**The Electric Merchandise Company,** of Chicago, received a few days since the following dispatch, the latter part of it referring to a duplicate order for four additional sets just ordered by mail: "Heaters working satisfactorily. Hurry the others along soon as possible. Ottumwa Electric Railway."

**An Identifier.**—The Illinois Metal Company, Royal Insurance Building, Chicago, has placed on the market a very neat, durable and attractive identification card that can be attached to the hat band, and, being dustproof and waterproof, will last for many years and prove invaluable in giving the owner's address in the event of an accident.

**A new printing and engraving house** has recently been formed by Messrs. E. E. Bartlett, Theo. von der Luke and Louis H. Orr, under the title of Bartlett & Co. They have opened offices and printing rooms at 21 and 23 Rose street, New York, where they will conduct a general designing, engraving and printing business. The members of the firm are gentlemen of experience and do first-class work. They will meet with an extensive patronage.

**H. Ward Leonard & Company,** of 136 Liberty street, New York, have recently issued a pamphlet of testimonials and references regarding past work, indicating the experience and standing of the company. It is made up of 32 pages of testimonial letters, all of which refer in the very highest terms to the efficient work which has been done by Mr. H. Ward Leonard and members of his present company in the line of electrical engineering and contracting.

**The Chicago Heights Land Association,** 807 Chamber of Commerce, Chicago, has secured two more large manufacturing establishments to locate at the Heights, and has also awarded a contract for macadamizing the streets and building stone sidewalks to the extent of $170,000. No assessment will be made for the improvements, the association assuming the entire expense. This association offers some special inducements to electrical manufacturers.

**The W. S. Hill Electric Company,** of Boston, has recently issued a supplementary catalogue of electrical appliances, which will be followed in a short time by a larger and more complete work, which will be profusely illustrated, and will contain representations of new specialties never before put on the market. The company has recently opened an office in the Electrical Exchange Building, 136 Liberty street, New York, which is in charge of Mr. E. A. Des Marets.

**Alexander, Barney & Chapin,** of 20 Cortlandt street, New York, have on exhibition a novel cigar lighter, the invention of Mr. P. H. Alexander. The cigar lighter hangs the same as a telephone on any electric fixture, and a feature of it is that it is made in the shape of an ordinary pipe, inside of which is run platinum and asbestos. By this arrangement it is not necessary to have the light turned on except when the lighter is in actual use. It can be attached to any incandescent lamp, and any cigar store can afford to have one.

**Weather Strips.**—The Q. & C. Company, Phœnix Building, Chicago, is receiving many orders from local electric supply dealers and bell hangers for its patent weather strip operating by gravity. Thus, when placed on a door, the shape of the lower half, or apron, is such that the part back of the hinge is heavier than that in front, and therefore drops as the door is opened, thus elevating the front or lower edge, allowing it to pass freely over the threshold. In the act of closing the door, the front edge of the apron comes in contact with a roller and is thrown down, the rubber making a close joint on the threshold.

**The Star Electrix Company,** of Philadelphia, will place upon the market within a very short time something new in the line of imported ivory, china and jet switches, which are specially designed for fine residence lighting and places where an artistic article is desired. A three-point switch which this company manufactures is designed for lighting and extinguishing a lamp from either of two separate points. In addition to having switches made entirely of china, this company also manufactures an all-metal switch, which can be used where white porcelain is objected to. All of these switches are made with an improved, unbreakable handle.

**The Consolidated Electric Manufacturing Company,** of Boston, has issued a neat illustrated catalogue and price list of the various specialties in the line of electrical supplies manufactured by the company. The more prominent specialties are brought to notice in such a manner that a customer so desiring can act intelligently when ordering supplies direct from the published list. This company has the reputation of manufacturing a large number of very fine specialties in the electric light and power, electric railway and electric bell and gas lighting line, and a perusal of the catalogue referred to convinces one of the fact that the list is a large and extensive one.

**The Safety Insulated Wire and Cable Company,** of 234 West Twenty-ninth street, New York City, has taken several important contracts lately. Among others are the wires and cables for the new monitor "New York," now being built by Messrs. William Cramp & Son, of Philadelphia, Pa. The cables are all lead incased, and their total weight is over ten tons. Another very large order taken by this company was for over 2,300,000 feet of single wire, given by one of the largest companies interested in the electrical industry. The Safety Insulated Wire and Cable Company was never more busy than at the present time, and has orders enough ahead for several months.

**Dynamo Brushes.**—We have recently received a neat little circular issued by the Electrical Supply Company, of Chicago, describing a new form of dynamo brush, involving a principle of construction designed by Chas. Wirt, in which a lamination of perfect and imperfect conducting materials is arranged. The good or copper conductor is placed in the middle, and has on each side a layer of high resistance metal, in sheets as thin as writing paper. This gives a certain flexibility, productive of smooth running. Also owing to the high resistance metal of the outer layers, the destructive short circuiting currents are prevented or "wire drawn," and consequently "sparking" is almost wholly eliminated.

**The Franklin Electric Company,** of 126 Liberty street, New York, is showing some remarkable tests in storage batteries which it manufactures. Some few days since the writer, when calling on them, saw a small cell, 1¾ x 5½ x 5½, with seven plates, which weighed 1¾ pounds, tested by the Weston standard voltmeter, on which it showed 2.4 volts, and when tested on a standard ammeter showed 125 ampères. This cell has been in use for some time, and the company claims that ordinarily on short circuits, the same as above, it shows over 140 ampères. The cell is designed for 25 ampère hours only. The 500 ampère hour cell put on the market by this company is especially designed for street railway work.

**The Sioux City Engine Works,** of Sioux City, Ia., has opened a branch office at St. Louis, Mo., Room 511, Commercial Building, corner of Sixth and Olive streets, which will be in charge of Mr. A. M. Morse, recently of the firm of English, Morse & Co., of Kansas City, Mo. Mr. Morse, during his eight years of residence in that city, has gained a wide acquaintance among the steam users of the Southwest, and has been awarded many important contracts for engines, boilers and complete steam plants for electric lighting stations, railways and manufacturing establishments. The company is prepared to furnish on short notice Sioux City, Corliss and Giddings' automatic engines with suitable boilers, and makes a specialty of complete steam power plants for any service.

**Mr. K. McLennan,** chief electrician of Swift & Co.'s extensive plants, has resigned that important position to take effect about Dec. 1, and will engage in the manufacture of electric specialties. For some two years Mr. McLennan has been supplying Gale's commutator compound to the trade, and of late the orders have rolled in so rapidly as to warrant an extensive increase in his factory. Mr. McLennan will also push the sale of the McLennan insulating compound, and now has facilities for turning out large quantities. One order received this week calls for 1,000 pounds, and in another order it is referred to as "the best insulating compound for making joints we have ever tried, and we shall use it hereafter in preference to others." Mr. McLennan's office, for the present, will be located at 3,841 Forest avenue, Chicago.

**An Enterprising Firm.**—The engineering firm of Zimdars & Hunt, of 127 Fifth avenue, is one of those concerns that seem to be doing good work in electrical construction as independent engineers. They have just completed an installation at Cornwall, N. Y., for lighting the streets and stores. The generator consists of a 40,000-watt Brush alternator. This generator furnishes the commercial lighting as well as that of the streets of the town of Canterbury. It also furnishes light to the military academy at Glen Ridge. The street lighting system consists of 80 four-ampère series Bernstein lamps. The power station contains one of the latest improved Paine engines of 80-h. p. capacity, and the boiler is of 100 h. p., manufactured by the Newburgh Steam Boiler Company. This concern has also just completed the wiring of J. Pierpont Morgan's steam yacht Corsair. In this installation the Crompton system is used. The company has also installed the entire equipment on Mr. Demorest's yacht Utranius. Both these marine installations are models of their kind. The construction work of this concern is ably attended to by Mr. J. P. Smith, who is one of the "Old Guard" and thoroughly conversant with all the points of electrical construction.

**A. L. Ide & Son,** of Springfield, Ill., report the following sales of Ide engines since Aug. 1, 1891: City Electric Street Railway Company, Little Rock, Ark , 1—25-h.p.; Sperry Electric Mining Machine Company, Chicago, Ill., 1—95-h. p.; Faust Electric Company, Rhinelander, Wis., 1—80-h. p.; Eureka Light and Ice Company, Eureka, Kan., 1—70-h. p.; Monticello Electric Light Company, Monticello, Ill., 1—125-h. p.; Edison General Electric Company, Argo, Colo., 1—80-h. p.; Decatur Street Railway Company, Decatur, Ill., 1—140-h. p.; Champaign & Urbana Street Railway Company, Champaign, Ill., 1—125-h. p.; Sperry Electric Mining Machine Company, Chicago, Ill., 1—105-h. p.; Citizens Street Railway Company, Memphis, Tenn., 5—1,250-h. p.; Danville Gas, Electric Light and Street Railway Company, Danville, Ill., 1—150-h. p.; Austin Water, Light and Power Company, Austin, Tex., 1—250-h. p.; Citizens' Electric Company, Pueblo, Colo., 2—250-h. p.; Thomson-Houston Electric Company, Chicago, Ill., 1—45-h. p.; St. Louis and Suburban Railway Company, St. Louis, Mo., 1—45-h. p.; Park City Light, Heat and Power Company, Park City, Utah, 1—60-h. p.; Edison General Electric Company, Denver, Colo., 1—45-h. p.; Thomson-Houston Electric Company, Chicago, Ill., 1—125-h. p.; Taylorville Electric Light Company, Taylorville, Ill., 1—75-h. p.; Modern Electric Light and Power Company, Pana, Ill., 1—60-h. p.; Danville Gas, Electric Light and Street Railway Company, Danville, Ill. (third order), 1—150-h. p.; Jefferson City Light, Heat and Power Company, Jefferson City, Mo., 1—50-h. p.; Frankfort Electric Light and Power Company, Frankfort, Ind., 2—250-h. p.; Harvey Transit Company, Harvey, Ill., 2—250-h. p.; Hyde Park Electric Light and Power Company, Hyde Park, Ill., 1—150-h. p.; Riverside Edison Company, Riverside, Ill., 1—100-h. p.

**Messrs. Queen & Co.,** of Philadelphia, have recently placed upon the market a new voltmeter which is claimed to have many valuable features never before brought out in a single instrument. It is the invention of Mr. Frank Wagner, for a number of years connected with the Thomson-Houston Electric Company, now on the mechanical engineering staff of the University of Michigan, at Ann Arbor. It is of the "hot wire" type, depending, like the Cardew, on the expansion of a stretched wire which is heated by the passage of a current due to the E. M. F. being measured. This wire is connected with a long and very light aluminium index in such a way that the amount is greatly magnified. The "hot wire" is only about five inches long and has in series an extra resistance wound anti-inductively; by altering this extra resistance the instrument may be adjusted to different ranges. The stretched wire is exceedingly thin and therefore immediately assumes the maximum temperature due to the E. M. F. being measured; the voltmeter is thus exceedingly dead-beat and readings may be taken very quickly. It is direct reading for both alternating and direct circuits, the reistance being "non-inductive." Two ranges are offered with a maximum of 55 and 125 volts respectively; both ranges being graduated in single volt divisions from ½ their maximum reading, these divisions being nearly equal and covering about $\frac{1}{12}$ inch each in the 55-volt instrument and about $\frac{1}{24}$ inch each in the 125-volt instrument. A mirror is inlaid in the scale so that parallax is avoided in taking readings. Messrs. Queen & Co., as well as Mr. Wagner, have spent considerable time in developing and perfecting this instrument, and believe that they have brought out one which will be indispensable to working electricians and electric light inspectors. The form, as now exploited, is intended only for general testing work, and is not a station instrument in any sense of the word. It is almost entirely made of aluminium, a metal which Messrs. Queen & Co. are now using extensively, and is believed to be the lightest voltmeter made. Complete and calibrated, it weighs but 22 ounces. It is rectangular and smooth, and can easily be slipped into a good-sized pocket. It measures, outside, 7¾ inches by 4 inches by 2 inches. The instrument has few parts, and these are very strong, making it well adapted for transportation. The outside case of the "Wagner-Queen" voltmeter is an emery finished bronze, having a beveled glass on the scale. Each instrument is furnished in a neat carrying case, with leather handle. An attractive descriptive circular, No. 265, has recently been issued by the makers.

## Business Notices.

**Battery Cut-Out, Cheap.**—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

**To All Whom It May Concern:** It lately having come to our notice that some builders of tamden compound engines are copying our construction and design, we deem it no more than proper to give notice that this improved construction was patented Nov. 18, 1890, and is the exclusive property of this company, and that we shall protect our rights as against all builders or users of engines. The "Dick & Church" tandem compound engine as built by us was illustrated in THE ELECTRICAL WORLD of July 18, 1891, in which was shown cuts of the engine together with a full description of it. The advantages of this construction, as against any other known design are manifest, and others, as well as ourselves, evidently recognize it, but we trust this will be sufficient to prevent any further acts of piracy. At all events, we have endeavored to protect the general public by publishing this notice. It is our good fortune to own this design for tandem construction, and we suggest that other builders who recognize its important advantages should at least have the courtesy to write us before making use of it, no matter whether they propose to use an exact reproduction, or merely copy as near as they think will be safe and evade our claims. We should like them to at least do us the honor of letting us have the credit of possessing the merit of originality. Respectfully,

PHŒNIX IRON WORKS COMPANY,

MEADVILLE, Pa., Nov. 18, 1891.

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

## U. S. PATENTS ISSUED NOV. 17, 1891.

**463,154. Electric Arc Lamp;** William Jandus, of Cleveland, O. Application filed Dec. 4, 1886. In an arc lamp, the combination of a carbon holding rod, a hermetically closed cap at the lower end of said rod, a carbon clamp within said cap, and an arc inclosing globe open at its lower end and hermetically joined to the lower edge of said cap.

**463,155. Electric Lock;** Walter J. O. Johnson, of Chicago, Ill. Application filed Feb. 25, 1891. A lock operated by a closed circuit, a plurality of contact making keys any one of which at normal position closes the circuit, and a plurality of keys and one of which out of normal position closes the circuit, the keys of the first class being externally undistinguishable from the keys of the second class.

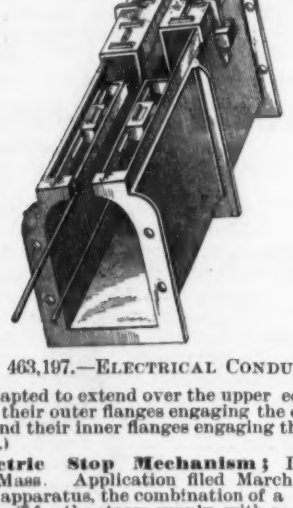
**463,172. Insulator Support;** Thomas Carpenter Smith, of Philadelphia, Pa. Application filed Feb. 1, 1890. An insulator supporting bracket consisting of two screw threaded insulator supports in substantially the same vertical line, a connecting part of ribbed or flanged metal, and a securing plate projecting laterally from the connecting part and making a substantially right angle therewith.

**463,174. Armature for Dynamos or Electric Motors;** Barron D. Southard, of Chicago, Ill., Assignor to the Chicago Electric Motor Company, of same place. Application filed March 2, 1891. A ring or disc armature composed of a series of separable sections, a series of coils of wire mounted upon these sections, and a series of tongues rigid with the sections projecting between the coils and field magnets, whereby the coils are retained in place and prevented from striking the field magnets.

**463,188. Telephony;** John W. Gibboney, of Lynn, Mass. Application filed July 28, 1891. The method of telephoning, consisting in making a record of sound waves, causing such record to produce slower electric waves, impulses or undulations of current of corresponding shape or character, transmitting such slow electric waves or undulations of current over an electric circuit, and recording such waves at the receiving end of the circuit.

**463,192. Electromagnetic Switch;** Charles H. Herrick, of Winchester, and Willis M. Rand, of Boston, Mass. Application filed Oct. 20, 1890. An automatic electric switch comprehending a base, fixed contacts thereon, an electromagnet arranged on said base, its armature having a hook or projection, a sliding spindle arranged in a vertical plane extended between the coils of said electromagnet, a switch plate, movable contacts thereon, a spring to normally separate said fixed and movable contacts, and a locking finger or projection movable with said spindle to be engaged by the hook or projection on the armature of the electromagnet to hold the fixed and movable contacts in electrical connection with each other while the electric current is maintained.

**463,197. Electrical Conduit;** John C. Love, of Philadelphia, Pa., Assignor to the Love Electric Traction Company, of Chicago, Ill. Application filed Feb. 10, 1891. The combination, with the side walls of a conduit provided with rigid inwardly extending brackets of slot rails provided with depending flanges on both



No. 463,197.—Electrical Conduit.

margins, and adapted to extend over the upper edges of the said side walls, with their outer flanges engaging the outer surfaces of the side walls, and their inner flanges engaging the said bracket. (See illustration.)

**463,198. Electric Stop Mechanism;** Lemuel Mellett, of Somerville, Mass. Application filed March 21, 1890. In an engine stopping apparatus, the combination of a brake for the fly wheel and a cut-off for the steam supply, with means for actuating both devices simultaneously from a remote point through an electric circuit.

**463,207. Telephonic Relay;** Ephraim W. Weaver, of Philadelphia, Pa., Assignor to Lewis O. Howell, Jr., of same place. Application filed Feb. 18, 1891. The invention consists in the diaphragm of a magnetic telephone receiver and two contact pieces placed in the local circuit thereof, in which is placed a magnet and diaphragm for augmenting the sound waves. A condenser is connected with the local circuit, and a damper is arranged to engage with the diaphragm.

**463,213. Cut-Out;** Hermann Lemp, of Hartford, Conn., Assignor to the Schuyler Electric Company, of Connecticut. Application filed June 21, 1887. The combination, with an incandescent lamp, having an exhausted or substantially exhausted globe, of a normally open shunt around the same and a manometric circuit closer normally communicating with the exhausted space and positively actuated by the pressure of air admitted to the lamp or gas generated therein to close and maintain closed said shunt.

**463,242. Dynamo-Electric Machine;** Martin C. Burt, of Chicago, Ill. Application filed Jan 21, 1891. The combination, in an electric motor or dynamo, of a hollow armature shaft, a blower geared to said shaft and having its eduction pipe connected with the interior of the shaft, openings in the shaft within the armature, and an armature upon said shaft tightly closed at the ends and loosely wound between the same.

**463,247. Galvanic Battery;** Walter Ambus Crowdus, of Memphis, Tenn., Assignor to Jos. W. Allison, trustee, of same place. Application filed Nov. 21, 1890. In a galvanic battery, the jar thereof provided with an over-flow receptacle arranged to receive and hold the excess of electrolytic liquid as it increases in volume and prevent its overflowing the cell.

**463,248. Galvanic Battery;** Walter Ambus Crowdus, of Memphis, Tenn., Assignor to Jos. W. Allison, trustee, of same place. Application filed Jan 24, 1891. In a galvanic battery, the combination of the battery cell, an upright negative electrode, a connection plate of copper coated with mercury arranged within the cell to be submerged in the electrolyte, a circuit conductor leading from said plate, and an upright positive electrode arranged to rest upon and make contact with said plate beneath the surface of the electrolyte, whereby it is connected with said conductor.

**463,257. Ice-Breaker and Electric-Current Transmitter;** Charles Smith, of Wilkesbarre, Pa. Application filed Jan. 31, 1891. The combination, with a car and its running gear, of a current transmitter and ice-breaker consisting of a revoluble disc having a cutting edge connected to the frame of the car and means for adjusting said disc vertically. (See illustration.)

**463,298. Thermo Circuit-Closer for Electric Fire Alarms;** Application filed June 26, 1891. The combination, in a thermo circuit closer, of a stationary contact piece, a spring-actuated movable contact piece, and a frangible bulb containing an explosive, said contact pieces being normally kept out of contact by said bulb.

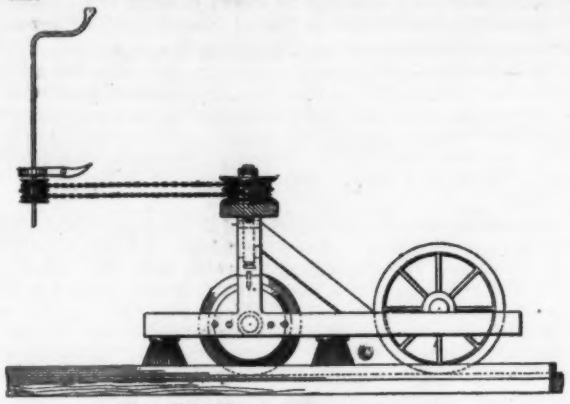
**463,305. Ore Separator;** William Durant Hoffman, of Brewster, N. Y. Application filed July 15, 1891. In a magnetic separator, a feeding device, a finishing magnet, a stratifying magnet located intermediate of the feed and finishing magnet, and means for conducting the material to be operated upon successively within the fields of the stratifying and finishing magnets.

**463,310. Crossing for Electric Railway Conductors;** William J. Silver, of Salt Lake City, Utah. Application filed Feb. 12, 1891. The combination, in a wire crossing for the wires of intersecting systems of electric railways, of an insulating hanger consisting of bars of insulating material supporting each wire and insulating one from the other, and guides, two for each wire, having downward inclinations towards the centre of the hanger.

**463,311. Electric Switch;** Ernest J. Bagnall, of St. Louis, Mo. Application filed Aug. 3, 1891. A means for securing a metal fuse in circuit, consisting in a knife edge throw switch, in combination with a rigid standard secured adjacent to one side of the spring clip standard between the members of which the knife edge of the pivoted circuit closer is adapted to enter, the said standard being secured in such a normal position as to readily admit the end of the metal fuse between it and the adjacent side of the spring clip standard.

**463,314. Alternating or Pulsating Current Motor;** Ludwig Gutmann, of Pittsburgh, Pa. Application filed April 7, 1890. The invention consists in providing means, such as a commutator and brushes, for maintaining a fractional number of coils of the armature, short circuited, inducing currents in such coils by the primary exciting coils, and reacting upon the said currents by the secondary exciting coils. (See illustration.)

**463,315. Power Storing Mechanism for Electric Locomotives;** James A. Hockett, of Stirling, Kan. Application filed Oct. 22, 1890. The combination, with an electric locomotive, of an electric motor, having a tubular armature shaft journaled on the axle of the car, the car wheel loosely fitted on the said axle, a clutch device, and a yielding device or spring connecting the loose wheel and clutch, whereby the power of the motor may be gradually applied to the wheel for the purpose of propelling the car.



No. 463,257.—Ice Breaker, etc.

**463,340. Fire-Alarm Telegraph Repeater;** Geo. M. Stevens, of Cambridge, Mass. Application filed April 30, 1891. In a fire-alarm telegraph repeater, the combination of a circuit breaking wheel, an electromagnet and its armature, a pivoted lever carrying said armature, a pivoted motor controlling lever constructed and arranged to have its main or long arm supported in a horizontal, or nearly horizontal position by said armature lever, and to be moved about its pivotal axis by the force of gravity when said armature is moved away from its magnet, a motor mechanism constructed and arranged to be operated by a weight, a locking mechanism for arresting the operation of said motor mechanism.

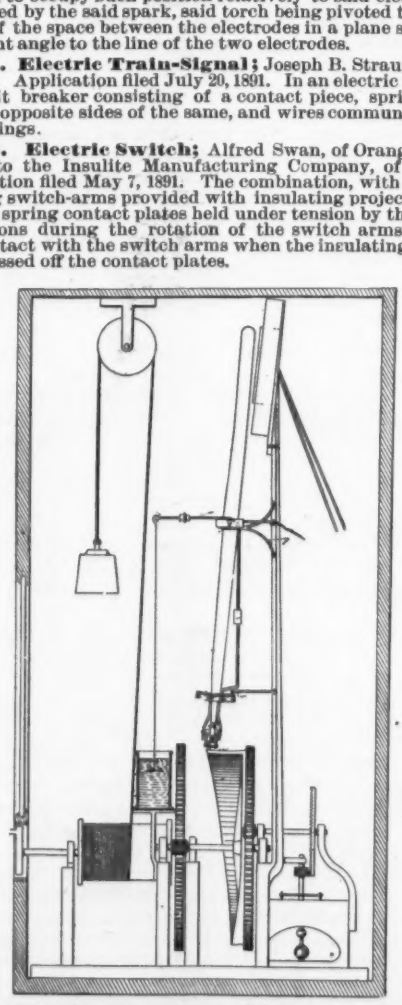
**463,356. Electric Locomotive;** Sidney H. Short, of Cleveland, O. Application filed April 8, 1891. The combination, with a car-truck, driving axles, wheels, and an electric motor, the latter being carried by a frame yieldingly supported on the car-truck, of bevel gearing connected with each axle, and insulated therefrom, and casings mounted on the axles for supporting and protecting the bevel gearing, and flexible connections between each end of the motor shaft and the shafts of the bevel gearing.

**463,359. Motor-Car for Electric Railways;** Thos. E. Adams, of Cleveland, O., Assignor to the Brush Electric Company. Application filed May 28, 1890. An electrically propelled vehicle or motor car, provided with a dome like elevation in the roof at the middle of the car, through the wall of which elevation the overhead line near the car is visible, and provided also with a trailing swiveled trolley or trolleys mounted on said elevation, the said vehicle or car having the motor-driver position in the middle of the car under said dome like elevation, and a coupler at each end, whereby it is adapted to draw other cars.

**463,384. Electric Cigar-Lighting Apparatus;** William W. Foster, of Boston, Mass. Application filed Aug. 14, 1891. The combination of two fixed electrodes, means for producing a continuous spark between said electrodes, and a movable torch or fuel carrier adapted to occupy such position relatively to said electrodes as to be ignited by the said spark, said torch being pivoted to swing into or out of the space between the electrodes in a plane substantially at a right angle to the line of the two electrodes.

**463,395. Electric Train-Signal;** Joseph B. Strauss, of Cincinnati, O. Application filed July 20, 1891. In an electric train-signal a circuit breaker consisting of a contact piece, springs bearing against opposite sides of the same, and wires communicating with said springs.

**463,396. Electric Switch;** Alfred Swan, of Orange, N. J., Assignor to the Insulite Manufacturing Company, of New York. Application filed May 7, 1891. The combination, with one or more rotating switch-arms provided with insulating projections, of one or more spring contact plates held under tension by the insulating projections during the rotation of the switch arms and thrown into contact with the switch arms when the insulating projections have passed off the contact plates.



No. 463,558.—Apparatus for Measuring Currents.

**463,402. Coupling for Electric Wires;** Francis X. Gartland, of Philadelphia, Pa. Application filed July 16, 1891. A coupling for electric wires, consisting of heads having an insulating pivotal pin, said heads having shoulders adapted to come in contact with each other, limiting the movements of said heads on said pins.

**463,428. Telegraph Sounder;** James Maret, of Mount Vernon, Ky. Application filed Feb. 3, 1891. In a telegraph sounder, oan electro-magnet having the poles bent or turned toward each other, a bracket or standard, an adjustable contact-screw in the standard passing between the inner ends of the poles, a striking armature in the standard, a sleeve adjustablein the bracket, a jam-nut, and spring for said striking armature.

**463,486. Process of Welding Metals Electrically;** Charles L. Coffin, of Detroit, Mich. Application filed June 9, 1890. The process of welding metals electrically, which consists in first separately subjecting the articles to be welded to the action of a hearing current and the voltaic arc and then pressing the heated articles together to form the weld.

**463,487. Electric Welding or Working of Metals;** Charles L. Coffin, of Detroit, Mich. Application filed March 4, 1891. The method of welding or working metal electrically, consisting in heating the part to be worked by contact with a conductor through which an electric current is passed and simultaneously springing a voltaic arc between said conductor and another conductor in proximity to said point of contact and welding or working the metal when raised to the desired temperature in any desired manner.

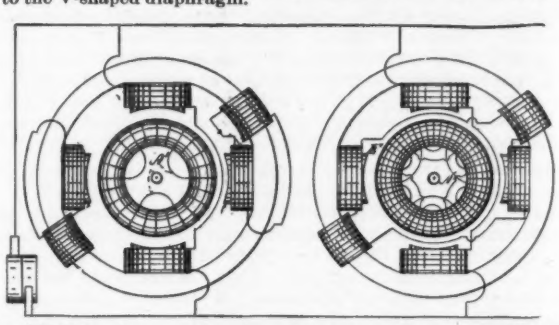
**463,491. Base Ball Indicator;** James L. Cutler, of Piketon, O. Application filed Feb. 24, 1891. In a base ball bulletin the combination of a main line with a mechanically actuated and electrically released rotary carriage or switch provided with a double series of non-conducting and conducting projections, a vibrating contact pawl adapted to engage said projections and controlled by the main line circuits, a series of local circuits respectively adapted to be closed by the contact of said pawl with corresponding conducting pins, a bulletin provided with display openings, and actuators in said local circuits adapted to display characters or blanks in said openings.

**463,512. Electrical Conductor;** Philip Henry Holmes, of Gardiner, Me., Assignor to the Holmes Fibre Graphite Manufacturing Company, of Chicago, Ill. Application filed June 2, 1891. An electric conducting composition made of compressed plumbago united by a drying oil as a binder and solidified and hardened.

**463,544. Multiple Telephone Switchboard;** Frank A. Pickernell, of Newark, N. J. Application filed Aug. 17, 1891. A multiple telephone switchboard, comprising main circuits, having normally discontinuous branches leading to connection terminals at its several sections, a relatively high resistance electromagnetic call device permanently included in each main circuit at some one of the said sections, means at each switchboard section for electrically uniting any two circuits by connecting their respective branch terminals, and a disconnecting annunciator of relatively low resistance, bridged between the direct and return conductors of any two circuits shunting the high resistance call devices of the circuits.

**463,545. Multiple Switchboard;** Frank A. Pickernell, of Newark, N. J. Application filed Aug. 17, 1891. This invention consists in combining with a multiple switchboard, in which the several main circuits branch to the several switchboard sections, electromagnetic call-receiving appliances responsive to currents of uniform direction only, clearing out or disconnecting annunciators responsive to alternating currents, and sub-station generators adapted at will to develop and transmit either alternating currents or straight currents having a direction to which the central office call-receiver can respond.

**463,556. Speaking-Tube Attachment for Telephones;** Leondo H. Snyder, of Sharon, Pa. Application filed Jan. 28, 1891. A speaking tube attachment for a telephone transmitter, consisting of a straight tube adapted to enter and cover the transmitter, a curved diaphragm in said tube near the front end, and a V-shaped diaphragm in the tube near the transmitter, and two or more curved tubes connected to said straight tube and leading from points in front of the curved diaphragm to points opposite to the V-shaped diaphragm.



No. 463,314.—Alternating or Pulsating Current Motor.

**463,558. Apparatus for Measuring and Recording Electric Currents;** William Thomson, of Glasgow, Scotland. Application filed Feb. 18, 1891. The instrument for measuring and recording electric currents, comprising the right angularly arranged straight bars having adjustable weights, and the indicator having connection with one of said bars, and the recorder pivoted to the lower end of the indicator by an axle supported by a suspended bracket. (See illustration.)

**463,569. Combined Telegraph and Telephone;** Emile Berliner, of Washington, D. C., Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed June 4, 1877. The method of producing in a circuit electrical undulations similar in form to sound waves by causing the sound waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit. An electric speaking telephone transmitter operated by sound waves and consisting of a plate sensitive to said sound waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them, caused by the vibrational movement of said sensitive plate. (See illustration, page 397.)

**463,570. Fire Alarm;** Alphonse Bichet and Robert W. Whitney, of Florence, Kan. Application filed Feb. 19, 1891. The combination with a turbine wheel, a supply pipe, and an electrically controlled valve, of a crank disc on the shaft of the turbine wheel, a pitman, a vertically movable arm, a pivoted hammer arm, the latter being connected with the said arm, and the bell arranged to be struck by the hammer.

**463,586. Mast-Arm for Electric Lights;** Van A. Thomas, of Providence, R. I., Assignor of one-half to Andrew D. Ross, of same place. Application filed Oct. 6, 1890. The combination, with a mounted mast-arm provided with parallel tracks insulated from each other and electrically connected with the poles of an electric lighting circuit, of lateral braces, and angle braces connecting and steadying said lateral braces.

**463,587. Insulator Bracket;** Van A. Thomas, of Providence, R. I., Assignor of one-half to Andrew D. Ross, of same place. Application filed May 21, 1891. An insulator bracket consisting of a base portion having bent laterally separated projecting sides or legs, and an insulator carrying portion secured to said base portion.

**463,588. Insulator Bracket;** Van A. Thomas, of Providence, R. I., Assignor of one-half to Andrew D. Ross, of same place. Application filed May 21, 1891. An insulator bracket consisting of an attaching or base portion provided with arms or hooks adapted to receive insulators, the axes of the hooks being inclined to the direction of the base and having the plane of the attaching face of the base parallel to said hooks.

**463,595. Duplex Arc Lamp;** Ernest P. Clark, of New York. Application filed Feb. 16, 1891. In an electric arc lamp having a plurality of pairs of carbons and separate regulating mechanism therefor, an automatic switch for controlling the circuits, and an independent electro-magnet located in the circuit of one pair of carbons, and having its armature connected with the switch.

**463,605. Circuit and Switch for Electric Motors;** Wilhelm Lahmeyer, of Frankfort-on the-Main, Germany, Assignor to W. Lahmeyer & Co., of same place. Application filed March 26, 1891. In an electric motor, the combination, with the motor armature and the coils of the field magnets, of a secondary armature fixed on the same shaft and means of switching the driving current through both the armature coils and the magnet coils, and to switch the driving current through the main armature coil and the current from the secondary armature coil through the coils of the electro-magnets.

**463,608. Automatic Fire-Alarm System;** Gilman W. Brown, of West Newbury, Mass., Assignor of one-half to Hayden Brown, of same place. Application filed Aug. 21, 1891. In an automatic fire-alarm system, the combination, with a main-line circuit, an electro-magnet located therein and provided with a polarized armature, and a receiving instrument controlled in its operation by the said polarized armature, of pole-changing thermostat located in the main line circuit and consisting of two sets of pole-changing arms, one set being normally not included in the said circuit by the melting of the fusible connection to re-establish the main line with reversed polarity after the said line has been opened by the operation of the fusible connection.